The FOUNDRY

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Castings Aid Production of Wrought Iron

ALTHOUGH the Aston process for the production of wrought iron has come to the front within the past few years, many tons of that material still are made by the puddling process. Whether the muck ball comes from the furnace or from the ladle as is the case in the new process, the ball must be worked and rolled into shape to be run

Rolls and Other Parts of Mills Used to Shape Wrought Iron Are Constructed of Castings

through the mills which make the iron into pipe, sheets, rods, etc. It is here that castings are used in the process. After the ball comes from the furnace, it is taken to the squeezer where its size is reduced. That machine is a heavy piece of equipment which must stand high stresses and maintain its rigidity. And because the requirements under which this machine operates are severe, castings have been selected as the engineering materials used in the construction of the machine. Following the squeezing operation the piece is taken to another type mill where the muck bars are produced. Often those bars are cut into short lengths and formed into bundles which are heated and again rolled. A large number of castings also are used in the construction of the shoes and other parts of the machine. This mill produces a semifinished product. The finishing operation then is performed on roll stands which are constructed largely of castings. The accompanying illustration shows one of the mills used for the production of bolt stock.

Find Where Castings Can Be Sold

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STEEL

By
Norman J. Hindle

Fig. 1 — (Left) — Four Machines of This Type Produce Side Frame and Bolster Molds. Fig. 2— (Center) — Equipment Used To Make Journal Box Cores

STATISTICS on production in 1929 show that the steel foundry industry enjoyed the best year since 1923 with reference to tons of castings produced, per cent of operating capacity and price secured for the product. Revised figures of the department of commerce show that 1,337,877 tons of steel castings were produced and that operations averaged 77 per cent of capacity during the past year.

A search for the reasons underlying this upward trend indicates that progress is due in a large measure to the concerted effort on the part of steel foundrymen to discover new uses for their product. The interchange of information not only by the presentation of papers at the various foundrymen's meetings, both local and national, but also the examination of production methods through the medium of reciprocal plant visitations also has been a contributing factor toward better business.

Probably the greatest single factor stimulating that industry has been the invention and application of mechanical equipment by which production costs have been reduced materially. Mechanical apparatus also has allowed the expansion of plant facilities without the cost of additional buildings, thus increasing production per square foot of floor space.

Several other factors such as increased quality of product, better control, new methods and improved apparatus also have contributed. However, in the final analysis, it is the production costs coupled with selling

Fig. 3—(Left) Green Sand Halves of the Cores Are Produced in the Space Between the Pairs of Molding Machines

Foundry Specializes in Railroad Castings

prices which guarantee a reasonable return on the investment that decides whether an industry is growing, progressive and profitable or stagnant, backward and profitless.

It was with a full knowledge of that underlying principle of successful business and a faith in the future of the steel casting industry, that Col. John Scullin organized the Scullin Steel Co., in St. Louis in 1899. Colonel Scullin already was a successful business man and owner of the St. Louis street railway. After deciding to embark upon the undertaking, he gathered together foundrymen, skilled in the production of steel castings and possessing thorough knowledge of the various phases of the casting process. About that nucleus, he built the organization of the Scullin Steel Co.

A tract of land was acquired on the outskirts of the city, a plant was erected and the necessary

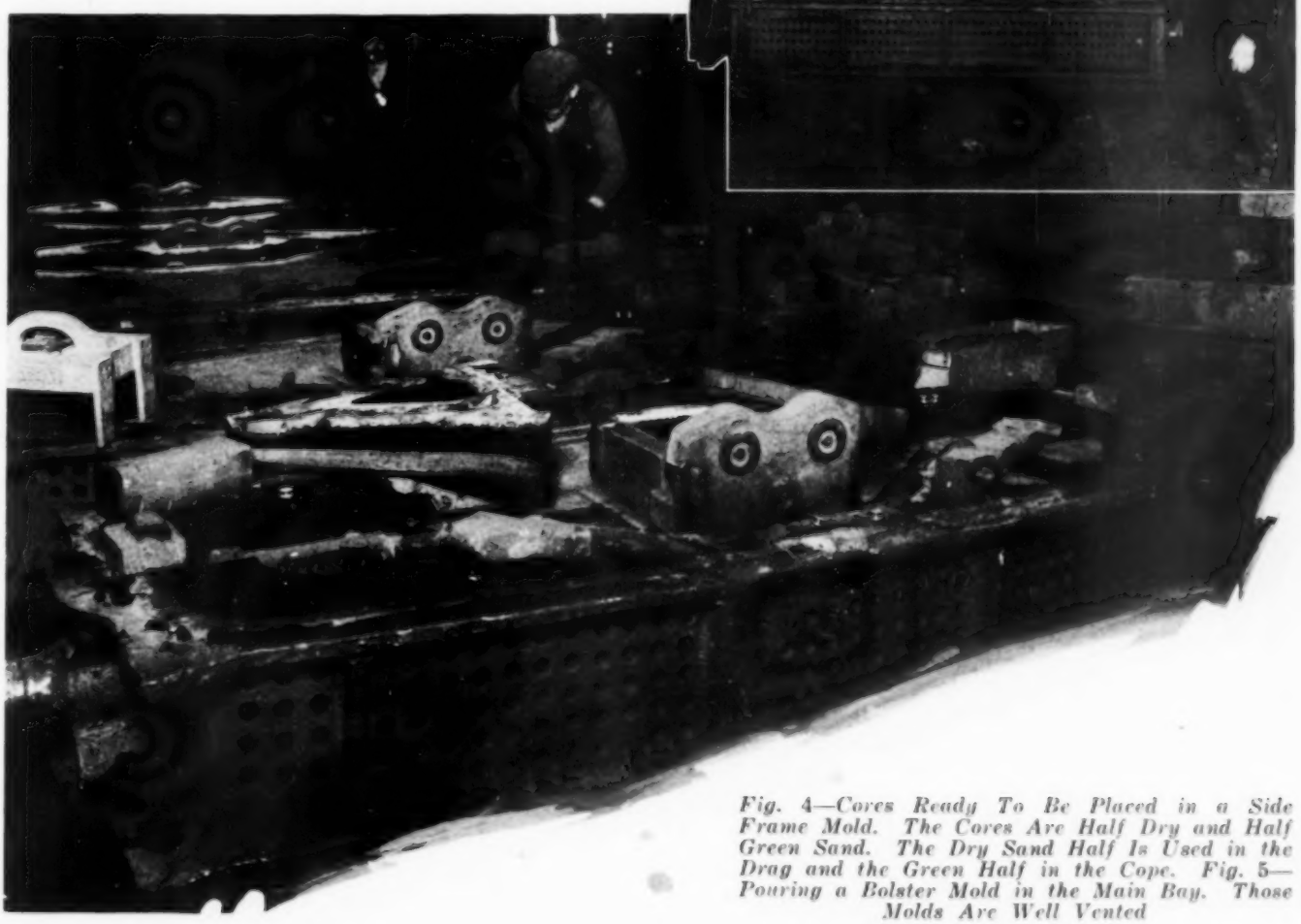


Fig. 4—Cores Ready To Be Placed in a Side Frame Mold. The Cores Are Half Dry and Half Green Sand. The Dry Sand Half Is Used in the Drag and the Green Half in the Cope. Fig. 5—Pouring a Bolster Mold in the Main Bay. Those Molds Are Well Vented

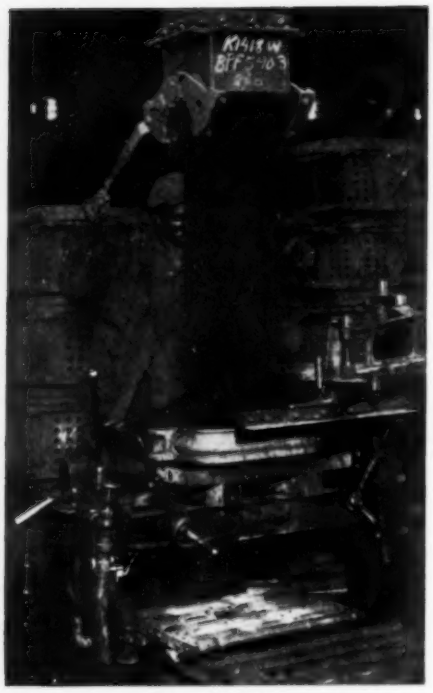


Fig. 6—Small Railroad Castings Are Made on This Machine

equipment bought and installed. The tract is about a mile in length and is bounded on one side by the Missouri Pacific railroad and on the other by the St. Louis & San Francisco railroad. These two railroads provide ample shipping facilities.

The Scullin Steel Co. specializes in the production of side frames and bolsters, these specialties absorbing 90 per cent of the foundry tonnage. The remainder of the metal melted is poured into molds for car, locomotive, and miscellaneous castings, such as sugar mill machinery, rolls, gears, propellers, etc. The company has facilities for the manufacture of gears of from 2 to 17 feet in diameter. Basic open-hearth steel is used in all castings.

Foundry Has Two Bays

Castings are made in the building marked foundry in Fig. 12. That building contains two bays 75 x 500 feet which are separated by the center line of columns of the building, and one bay 65 x 400 feet. The north bay is devoted to the production of miscellaneous castings and yokes and the middle bay to the manufacture of side frames and bolsters. The open-hearth department is located in the south bay of the building.

The northwest corner of the bay where miscellaneous castings are made is allotted to the storage of patterns that are being used in that section of the foundry. The remainder of the floor space is devoted to molding, with the exception of an area at the east end of the bay where a shakeout is located. Molding machines are installed along the center line of columns that separate the north and middle bays. Miscellaneous hand molding occupies the remainder of the floor. Two jolt, rollover, pattern draw, molding machines with jolters 40 x 72 inches, made by the Herman Pneumatic Machine Co., Zelienople, Pa., are located at the west end of that section of the bay devoted to machine molding. Those machines are used for molding yokes. They are 80 feet apart, one machine making the copes and the other the drags. The molds are pushed onto gravity conveyors and transported to a point midway between the machines, where the cores are set and the molds are closed.

Two additional molding machines, with jolters 30 x 40 inches and also made by the Herman company, used for making car castings such as strikers, center fillers, etc., and the swing arm, mold filling device, made by the C. O. Bartlett & Snow Co., Cleveland, located between the yoke making and the smaller machines, also are used. Two machines in the east end of the building, made by the Osborn Mfg. Co., Cleveland, are used to make molds for brake heads, brake shoes, draft lugs, and similar castings. This completes the molding equipment in the north bay.

The dry sand molding floor is located opposite the two 30 x 54-inch machines and west of that floor is a roll pit. Ample crane service is provided by two 10-ton capacity cranes made by the Morgan Engineering Co., Alliance, O., one of 20-ton capacity manufactured by the Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.; and one with a capacity of 30 tons supplied by the Alliance Machine Co., Alliance, O.

The swing-arm mold-filling device, previously referred to and shown in Fig. 7, is located between the machines used to produce yoke molds and those employed in the manufacture of the smaller castings. The device consists of an arm pivoted at the point where it joins a hopper which delivers sand to the apparatus. Sand drops from the hopper onto a belt which conveys it to the end of the arm and drops it into the flask below. The arm is capable of delivering sand to any desired point on the arc of a 16-foot diameter semicircle. Flasks are placed along the arc and the arm is spotted over each in turn and delivers a quantity of sand. Castings molded by that method usually are of fair size and for that reason sand usually is added in several portions to each mold. After each addition the sand is rammed with pneumatic rammers. Those operations are continued at regular intervals until the mold is completed. That piece of equipment is practically in constant use.

Produce Side Frames

The middle bay of the foundry is devoted to the production of side frames and bolsters. Four large molding machines made by the Herman Pneumatic Machine Co., Zelienople, Pa., of the type shown in Fig. 1 are used in that work. Those machines have jolters 40 x 124 inches. Side frames

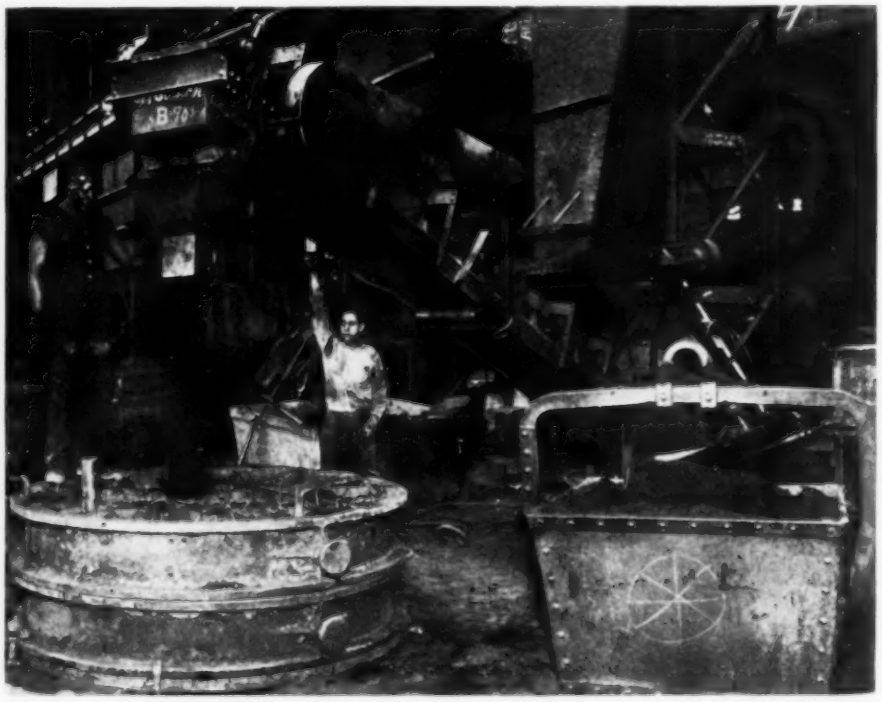


Fig. 7—A Swing Arm Mold Filling Device Delivers Sand to Molds on a 16-Foot Semicircle

and bolsters are made in green sand molds with half green and half dry sand cores. Journal box cores are all green sand. A side frame mold is shown in Fig 4 with one core set and the remainder lying on the sides of the mold. These molds are poured with a two-sprue gate and are well vented to allow the mold gases to escape. An idea of the amount of gases generated in a mold of that type may be gained from Fig. 5, which shows a bolster mold being poured. Only four gaggers are used in each side frame mold, due to the fact that special flasks which will be described later are used for that work.

Machines Work in Pairs

The four machines previously mentioned work in pairs, one in each pair making copes and the other drags. The pairs of machines are 140 feet apart. As each section of a mold is completed, it is removed from the machine by a crane and placed on rails that extend the entire length of the molding floor. During the month of December the average production of that floor was 370 molds per day for two nine-hour shifts or 185 molds per shift. The largest number of molds ever produced on one shift by the company is 210. The Scullin Steel Co. considers that a record for that type of work.

All cores used in side frame and bolster molds are *green-halved*, the upper half being green sand, the lower half dry sand. The green halves of the cores are made on the molding floor in part of the area between the molding machines. The remainder of the space is devoted to finishing, core setting and closing the molds. Fig. 3 shows some of the equipment used to make cores for those castings. Fig. 2 shows the apparatus used to make

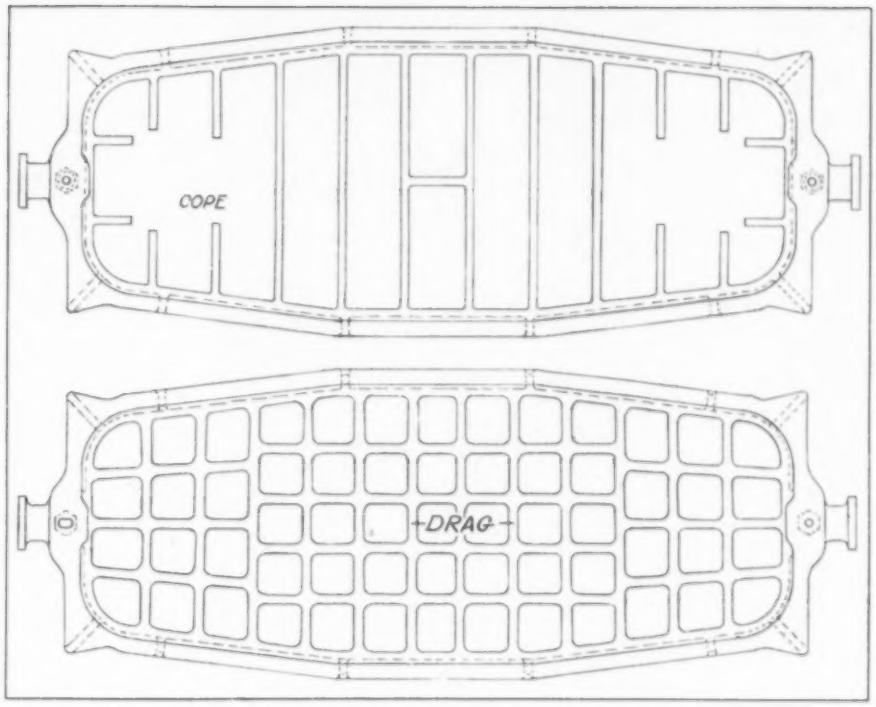


Fig. 8—Layout of the Side Frame Flasks Used in the Shop

journal box cores which are cast integral with the side frames. Cores are made as they are required. Twenty-five men constitute each gang which consists of core makers, molders and finishers.

The middle bay also is well equipped with cranes. Six gantry cranes made by the company are used in transporting and closing of molds and moving flasks. Those cranes are 32 feet long and have five-ton trolleys. Four overhead cranes supplement the gantry crane service; the largest has a capacity of 50 tons and was supplied by the Whiting Corp., Harvey, Ill. A 20-ton and one 45-ton capacity complete the crane equipment.

Cast steel flask equipment is used exclusively in this shop. The flasks are cast solid with no loose ends, and are equipped with case hardened, hexagonal top, steel bushings and steel guide pins. Bars in the top of the cope and the grids in the bottom of the drag are cast integral with the flask. The bars in a cope of a bolster flask may be seen in Fig. 5. These hold the sand in position and reduce the number of gaggers required for that purpose to four. About ¼-inch of extra metal is cast on the bottom of the drag flask. After the molds are finished they are set on rails and this extra material raises the mold slightly above the rails so that they do not bear on the mold. No bottom boards are used on the flasks.

Fig. 9—Sand Is Reconditioned in Four Mills Before It Again Is Distributed to the Molding Machines

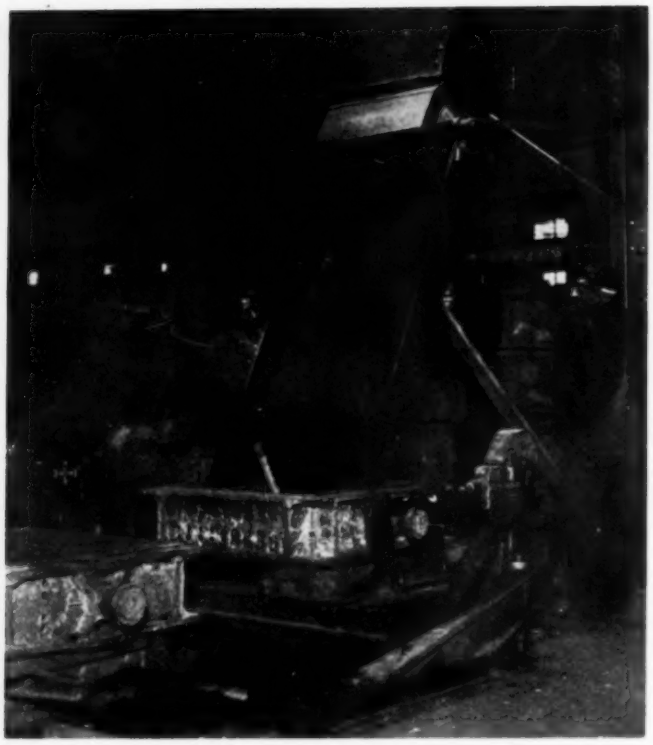


Fig. 10—Another Type Molding Machine for the Production of Miscellaneous Railroad Castings

After the cores have been set and the mold has been closed, one of the overhead cranes picks the mold up and places it in the pouring department, which occupies about half the middle bay near the furnaces. This bay is outside the gantry crane runway. The flasks are placed on rails that extend the entire length of the pouring bay. Before the molds are poured, a runner cup is placed in position over the sprue. The cups are made of dry sand from a mixture of 1/3 new silica sand, 2/3 old sand that has been through the sand conditioning system, and 80 pounds of fire clay. Water is added to give the correct moisture content.

Use Two Mixtures

Two sand mixtures are used in this shop. Facing sand is made in 2500 pounds batches consisting of all new silica sand, 80 pounds of fireclay, and a quantity of bentonite that varies with the weather conditions. Approximately 3 per cent moisture is used in that mix. The second mixture used which has been through the sand conditioning system, consists of all old sand, one shovel of fireclay and 3 per cent moisture. Only 30 pounds of new sand are consumed per side frame and most of that is used at the gate. Four hundred pounds are required for each ton of castings produced. New sand shipped to the plant must have a fineness under 40 as determined by the American Foundrymen's association method.

A sand handling system recently was installed in this shop by the C. O. Bartlett & Snow Co., Cleveland. That system supplies sand to both the north and middle bays of the foundry. The reconditioned sand is used both as facing and backing material. The system is designed to handle 125 tons per hour. After the molds have been poured they are taken to the shakeouts located at the ends of both the north and middle bays, where the sand is knocked from the flasks by vibrators made by Stoney Foundry Engineering & Equipment Co., Cleveland. The sand falls on a grating where the large lumps are broken up and gaggers, scrap, etc., are separated from the mass. Sand falls through the grating onto an endless apron conveyor at right angles to the main collecting belt which follows the center line of the columns between the bays. Sand is delivered to the latter conveyor by the shakeout apron conveyors and is taken to a bucket elevator. At the end of the collecting belt, sand passes over a magnetic pulley where all rods, gaggers, nails, etc., are separated from sand before entering bucket elevator, which conveys it to a revolving screen. Here hard cores, oversize lumps, wedges, etc., are removed and the sand falls upon a conditioning belt where water is added.

Following the water addition, the sand is transported to a squirrel-cage type sand conditioning unit which fluffs, aerates and cools it. The sand then is transported to a 150-ton storage bin. The sand is removed from the bottom of the bin by a grid with a reciprocating motion and falls upon a belt which conveys it to an elevator which delivers the sand to a belt conveyor. The sand is distributed by the latter conveyor to four 45-ton hoppers mounted over sand mixers.

Sand Is Measured

Four mixers made by the National Engineering Co., Chicago, condition the sand. A measuring device that is used to proportion the sand going to the mixers is provided under each of the hoppers located above the sand mills. The correct amount of sand is measured into the mill, approximately a shovel of fireclay is added, depending on weather conditions, and the correct amount of water is added. The batch is milled for 1.5 minutes. That may appear to be a short period of mixing time, but when it is considered that the sand was partly tempered on the conditioning belt previouly referred to the time seems more reasonable.

The tempering of the sand is left to the discretion of the mill operator.

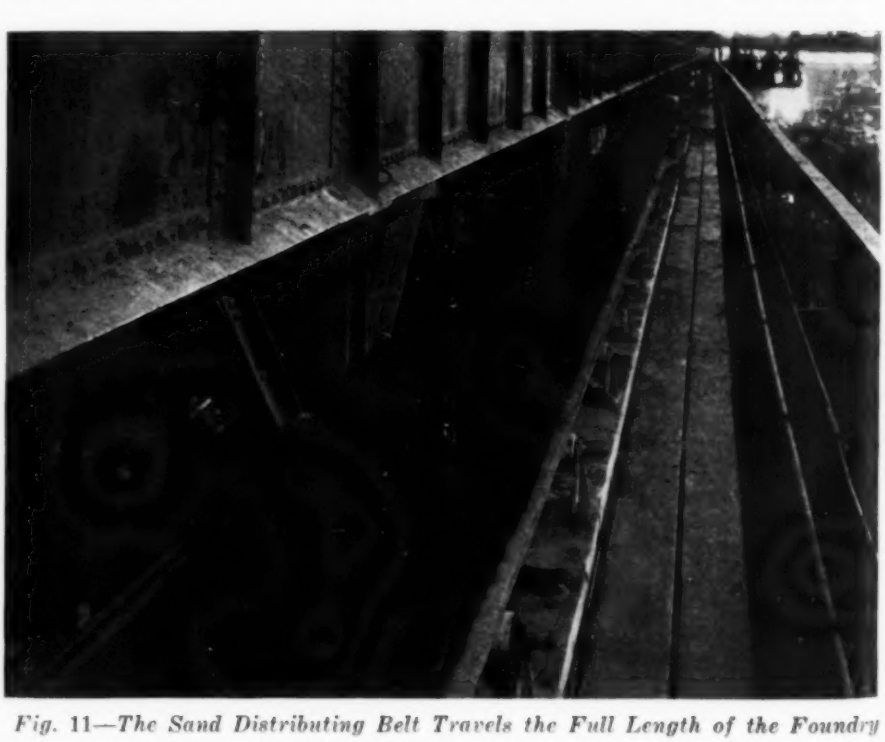


Fig. 11—The Sand Distributing Belt Travels the Full Length of the Foundry

Following the tempering, the sand is dumped from the mixer upon a collecting belt which carries it to the main distributing belt. That conveyor distributes it to the various storage bins throughout the foundry. The main distributing belt extends the full length of the foundry, a distance of 500 feet. It is one of the largest one-piece belts ever made by the Goodyear Tire & Rubber Co., Akron, O. The belt travels at a rate of 115 feet per minute and requires 9 minutes and 15 seconds to make a complete revolution.

Castings produced by the Scullin Steel Co. are made from basic open-hearth steel. Metal is melted in four used, 8400 pounds of the former and 8600 pounds of the latter. Four thousand pounds of burned lime are charged as a slag material. Approximately 2700 pounds of dolomite and 500 pounds of magnesite are used to keep the bottom in condition. Additions include 520 pounds of 80 per cent ferromanganese and 590 pounds of 50 per cent ferrosilicon. Ferrosilicon is used as a deoxidizer.

Each furnace produces four heats per day. Heat is reversed on the furnace at 20-minute intervals at the beginning of the heat. That time is reduced to 10 minutes toward the end. A large part of the heat contained in the outgoing gases is reclaimed by turned on and the materials are allowed to fuse into the lining. Material is charged with side frames and bolsters on the bottom, next the burned lime, then heavy scrap, baled scrap and pig iron in the order named. A hot flame is used throughout the heat both during the melting and refining periods.

The charge melts in approximately 4½ hours. At that time a test is taken from the furnace and the carbon is estimated by the melter. Iron ore then is added to the bath to reduce the carbon. Tests are taken from the furnace at intervals during the refining period and the melter estimates the carbon content of the

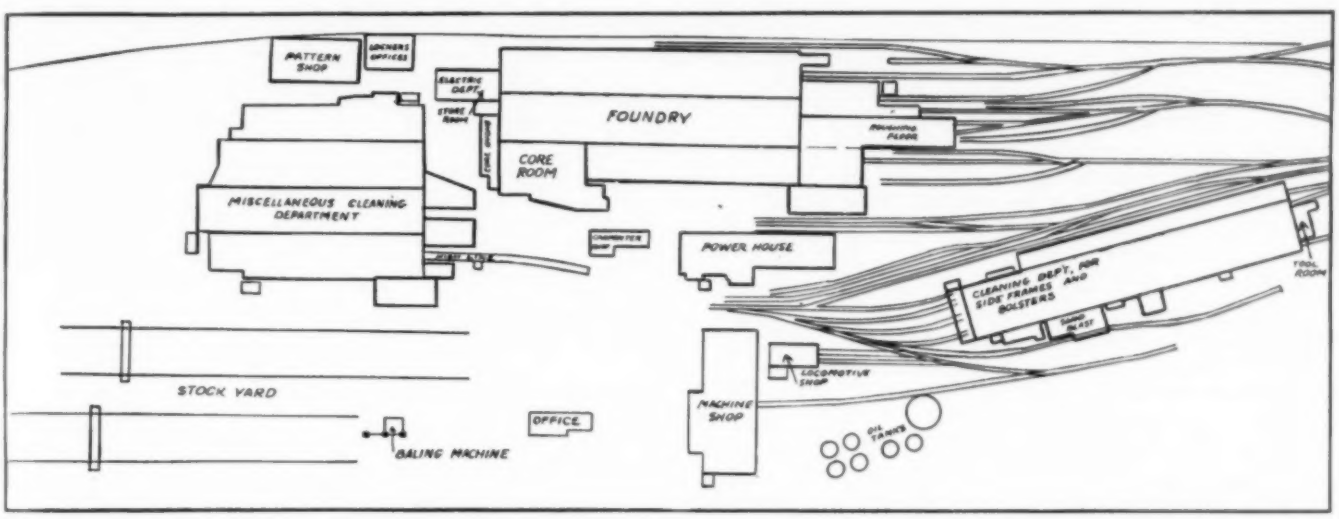


Fig. 12—Layout Showing the Location of the Buildings in the Foundry Department of the Scullin Steel Co.

30-ton capacity furnaces located in the south bay of the foundry building. Steel produced has an average analysis of carbon, 0.25 to 0.35 per cent; manganese, 0.80 to 0.85 per cent; silicon, 0.40 to 0.45 per cent; phosphorus, 0.018 per cent, and sulphur, 0.026 per cent. Physical properties average 39,000 pounds per square inch, elastic limit; 72,000 pounds per square inch, ultimate strength; 34 per cent elongation and 48 per cent reduction of area. American Society for Testing Materials specification for class B steel castings for railroads, which includes side frames and bolsters, gives the following properties: Elastic limit, 36,000 pounds per square inch; ultimate strength, 60,000 pounds per square inch; elongation in 2 inches, 22 per cent, minimum; reduction in area, 30 per cent, minimum.

An average charge used in the furnaces consists of 43,000 pounds scrap and 17,000 pounds pig iron. Of the scrap, 20,000 pounds are heavy melting scrap, 7300 pounds bolsters and side frames, 6000 pounds baled scrap and 8800 pounds rails. Both Northern and Southern pig iron are waste heat boilers. The steam generated in that manner supplies a part of the power for the plant.

Equipment on the charging floor includes a five-ton capacity crane and a charging machine made by the Morgan Engineering Co., Alliance, O. Charging material is loaded with yard gantry cranes in cast steel charging boxes and transported to the furnace platform on charging cars. The boxes are taken from the charging cars by the charging machine. That piece of apparatus picks up the boxes from the buggies that have been pushed into position in front of the furnace doors, shoves them into the furnace through the doors, rotates them, thus emptying them, withdraws them and places them empty on the buggies. The operation is repeated with each charging box until the furnace has been charged in the manner previously described.

After a heat has been tapped from the furnace at the Scullin Steel Co., dolomite and magnesite are thrown into the furnace along the bottom, breasts and slag line to keep those parts in condition and to remedy any defects in the lining. The flame is bath by the appearance of the crystal structure shown in the fracture of the test piece. When he judges the carbon to be reduced sufficiently, 16 per cent ferromanganese is added to the furnace and 15 minutes later the heat is tapped into a 30-ton capacity, bottom pour, ladle suspended from a crane. Ferrosilicon of the 50 per cent variety is added to the ladle as it is being filled. Eighty per cent ferromanganese is added in runner spout as heat is tapped. When the furnace is empty, the ladle is moved to the pouring floor and the molds are poured.

Ladles are preheated at the furnace before they are used. A section of the north bay of the foundry east of the molding floor, 75 x 140 feet, is allotted to the preparation of ladles. Another section in the southeast corner of the building and east of the furnace platform is used for the preparation of stoppers and gagger reclamation and a repair department.

This is the first of two articles on the manufacture of railroad castings at the plant of the Scullin Steel Co., St. Louis. The second and concluding article of the series will appear in an early issue of The Foundry.—The Editors.

EDUCATORS PAVE WAY for Co-operative Effort

Comments Show Need of Properly Administered Foundry Practice Course in Engineering Curriculum

WHEN Professor Beese of Pennsylvania State college addressed his inquiry to a number of prominent foundrymen regarding advisability of teaching of foundry practice as a part of an engineering course, he started a discussion which continues to gain momentum. Since the discussion of this letter appeared in the March 15 issue of THE FOUNDRY, members of college facilities, engineers, and practical foundrymen have commented extensively on the subject.

Many of the comments point to the place occupied by the foundry as a basic industry. The information presented in letters received by THE FOUNDRY in practically all cases indicate that the industry is in a healthy condition. In fact, Charles C. Leeds, Carnegie Institute of Technology, Pittsburgh, believes that intense competition has been of great benefit to the foundry. Mr. Leeds has the following to say:

One of the best things that has happened to the foundry industry in recent years is the threat of welded steel construction. There are many foundries known to your readers where some such scare as this was necessary to force consideration of better production methods, to impress foundry executives with the need for replacing guesswork as to costs by analytical studies, to replace costly manual labor by machinery for molding and material handling.

Teaching Is Worthwhile

Mr. Leeds also believes emphatically that the engineering school can teach a student something worthwhile about foundry practice. In brief, he has the following to say on this subject:

If critics of foundry instruction to engineering students are thinking in terms of manual skill, they are undoubtedly justified in their beliefs as with the limited time given to the subject in most engineering schools skill cannot be acquired. However, the manual skill gained by students of engineering is possibly the least of the values secured from the instruction given here at Carnegie.

The vocation of the foundryman is based upon certain fundamental principles which may be taught to engineering students just as well as to foundry apprentices. In fact, as generally practiced, the engineering student should and often does more readily grasp these principles than the foundry apprentice. The reason is fairly simple. The major purpose of the college foundry is its use for teaching, while the main purpose of the commercial foundry is to get out its product at a profit, not to teach apprentices, the latter being merely an incident in all too many foundries where practice is taught with little thought given to principles. Further, while the engineering student at Carnegie is receiving his foundry instruction, on another day he is also given instruction in patternmaking. The instruction in both subjects is given concurrently and is so co-ordinated that each instructor's work supplements that of the other. In addition, as our time is limited it is highly essential that we shall teach principles and use foundry practice to illustrate their application.

Learn Foundry Terms

For certain branches of engineering, such as civil, mining, and possibly electrical, foundry instruction is of less importance than it is to the metallurgist and the mechanical engineer. However, each student in these courses learns the language of the foundry; he learns why patterns must be made in certain fashion and of certain materials; he learns about cores, their purpose, composition and methods of production, both of green and dry sand; he learns the fundamentals of producing castings, both through lectures and the use of his hands, on bench and floor work. Finally, he acquires an excellent general understanding of the position of the foundry in the whole production plan and of its importance as the source of certain parts essential in the production of machinery.

If the engineering graduate does not use his foundry knowledge to advantage when he is designing some mechanism, it is generally the fault of his instructor in machine design, not the foundry teacher, who usually has this student in the early stage before he is prepared to take up design questions. There is entirely too much designing done without considering production methods, but the blame for this condition should be placed where it belong—upon the instructors of machine design who do not know shop processing methods well enough to incorporate this important factor into their instruction.

If by encouragement one has in mind opportunity, the writer feels that the foundry industry, because of its very lack of progressiveness in many respects, offers a remarkable field for wide awake, well-trained young engineers, especially those young men whose interest has been aroused to the possibilities in this field, and who have kept this aim in mind when choosing a particular engineering course. If the above question is intended to ask: "What have foundry executives as a whole or foundrymen's associations done to encourage young engineers (not apprentices) to enter the foundry industry?" the writer is at a loss to recall any concerted effort in this direction.

Frederick G. Sefing, Michigan State college, East Lansing, Mich., has divided the question into two sections, namely cultural education and technical training. He says:

All the engineering students at Michigan State college are required to take the first course in foundry work, that is the one presenting the cultural aspects. Accompanying the work in the laboratory there is a class room work where discussions are held of the foundry's place in industry and the importance of metals to our daily living. This course is designed so that even liberal arts students would do well to take it.

Technology Is Separate

The technicalities of foundry work we believe should be given in a separate course and especially to the mechanical engineering students. This study should not only acquaint the student with the technology of foundry practices, but should also familiarize him with some problems of the foundryman and right here is the opportunity to interest the young man in the foundry industry so that he will be at least tolerant of its problems and possibly he may become interested enough in it to select it for his life work.

Providing the foundry and equipment of the college is kept up to date, John Younger, Ohio State university, Columbus, O., feels absolutely certain that colleges should teach engineers foundry practice. Mr. Younger summarizes as follows:

Our foundry has a capacity for thirty students working simultaneously. It is equipped with a modern cupola of 1500 pounds capacity; with two of the latest type molding machines; with the latest type flasks and their equipment. There is a large sand mixing and slinging machine of the latest type; and we have recently installed a new core oven of the individual drawer type.

In connection with this foundry we run a sand testing laboratory in which molding sands are tested as regard to

bond, moisture and other characteristics. We are at present engaged on some important research in the nature of synthetic foundry sands.

Everything which our foundry produces is used in the machine shop. We do not merely make castings for the pleasure of seeing them thrown back into the cupola; our castings are commercial products for our own use. I think this point should be emphasized; in other words, the foundry is a necessary and valuable adjunct to the machine shop. We cast gray iron, bronze, brass, aluminum, and are hoping to do some research work with aluminum alloys.

Co-ordination Has Value

We believe that the co-ordination of mind and body in the work of the foundry is of great benefit educationally to the student. We believe that the training the student will get in a well equipped foundry will be of value to him in his after career in engineering.

We realize that welding is making tremendous strides; in fact we have a complete welding unit in our department. But we cannot visualize the time when castings will be displaced entirely by welding; there will always be an important place for castings.

Incidentally, the work of our foundry ties up closely with our industrial engineering work. For example, our students are given the problem of finding the cost of a metal produced in the foundry. They have to do time study work under foundry conditions; they employ their course in cost accounting to find out the overhead and so they arrive at the cost per pound of the casting.

In the opinion of E. D. Soderstrom, associate professor of industrial engineering, Oklahoma Agricultural & Mechanical college, Stillwater, Okla., the foundry course should be correlated with the other subjects offered in the engineering courses. Mr. Soderstrom explains how this is accomplished as follows:

A technical education must necessarily include a wide basic education arrived at by study of sciences from many angles. Engineering consists of securing as many facts as possible concerning the work at hand and balancing one set of facts against another until a satisfactory or at least a working solution has been arrived at. The students take courses for instance in physics, chemistry, and testing of materials, all more or less abstract book work. In the foundry I try to parallel and vitalize their work by calling attention to such items as static pressure, heat of fusion, specific heat, combustion as exemplified by proportion of coke, iron, and air in cupola.

I consider the foundry as a basic laboratory, in metallurgical chemistry. Why are certain castings too hard? What is the effect of using various mixtures of ferrosilicon, ferromanganese, and steel in the mixture as exemplified by test bars. In the nonferrous field what are the effects of heat on aluminum and on copper alloys? What mixtures produce alloys of good strength? What reaction may take place in the furnace and what may be done to strengthen castings by subsequent heat treatments? The foundry is the natural and logical place for the students to begin the study and secure at least some of the answers to these questions.

Mr. Soderstrom also outlines the course offered as follows:

The mechanical, electrical, and industrial engineering students take foundry practice three hours per week for 18 weeks. We cast gray iron, brasses and bronzes, and aluminum. We do no exercise work, every mold is set up for the purpose of producing a casting. The gray iron includes a general run of small castings—grinder parts, jackscrews, and other machine parts for our machine shop, and meter box tops, man hole rings and covers for the city. In aluminum we cast a variety of small work including emblems, auto step plates, booster signs, skillets, waffle iron, etc. In the field of brasses and bronzes we cast some mill brasses, and ornamental work including, book ends candle sticks, tablets, etc. We have just completed an order for 400 federal aid highway bench markers for the State highway commission.

For beginning instruction in handling iron I use a small cupola which I designed for that purpose. A detailed description is given in THE FOUNDRY, Aug. 1, 1928. We melt aluminum in a home-made natural gas furnace, using cast iron pots.

It may be more difficult to state why we teach foundry practice to engineering students. One reason is seeing is believing. I have had engineers come into the shop and want to see or feel in connection with material they were using in designing equipment. They had their data from handbooks and had figured all stresses and strains but as one old engineer said, in explanation, "I am never quite satisfied with a design until I can see and feel the material that I am going to specify."

Shop Courses Scrutinized

Arthur B. Domonoske, executive head mechanical engineering department, Stanford university, Stanford, Calif., believes that not only the foundry course, but all shop courses are under careful scrutiny and are somewhat on the defensive in engineering schools. Mr. Domonoske says:

The primary purpose is no longer to provide manual skill alone, but to give the student some knowledge of shop terms and insight into elementary industrial processes. No attempt can be made to make journeymen mechanics, and apparatus installed solely for that purpose can not be justified. Like all laboratories, shops are for the purpose of illustrating classroom lectures or to make more understandable other courses such as machine design or machine drawing. They also further serve in holding the student's attention during the first few years when he is overloaded with mathematics, physics, and chemistry and does not realize the part these latter courses play in his technical education.

Various suggestions have been made regarding methods to replace the school shops, such as the use of moving pictures and visits to commercial establishments. Before a student can receive much benefit from a visit to a commercial shop he must have an idea of the fundamentals, otherwise the noise and comprehensive nature of the operations carried on will cause him to wander through the establishments as if in a dream. The impression on his mind will be a big blur instead of clarified individual operations. Moving pictures, unless slow-motion, are too rapid for the student to distinguish elementary operations. Some institutions, as Stanford, are located thirty miles or more from commercial centers and consistent shop visits are hard to arrange.

The amount of equipment to be installed and floor space to be provided for shops will vary with the individual university. In the last analysis it is the personnel that really counts. The actual method and apportionment of manual instruction to classroom lectures does not matter as long as satisfactory results are obtained. The keeping of the teaching personnel up to date and conversant with modern shop practice is as important, if not more important, than the instructional methods.

Comments on Patternmaking

An interesting angle of this discussion is pointed out by Andrew C. Hoak, Niagara Falls, N. Y., who believes that the pattern shop is facing a common problem with the foundry, since the engineer is not familiar with foundry practice. Mr. Hoak has the following to add to the discussion:

Failing to see a comment from the patternmaking branch of the industry prompts me to contribute a whole hearted indorsement to the views an opinion expressed that the engineering student should receive foundry training. Is not the patternmaker especially the jobbing shop patternmaker facing the problem in common with the foundryman regarding the engineer not being familiar with foundry practice? This is quite apparent in design also in purchasing, where frequently the purchasing agent is an engineer.

Having given this question much thought and also the one of apprenticeship training makes me hopeful, now that the question has become an open one, a practical means toward the solution of each will be taken by interested parties. The program of enlightenment and the furnishing of true and up to date data regarding the desirable properties of cast metals also should act to quicken the interest of the engineer in foundry methods.

Although not an engineering graduate I have received technical as well as practical training in the foundry. It is my opinion, however, that sentiment on the part of industry against employing these men in changing and with proper encouragement and cooperation it offers a means toward solving the apprenticeship problem, at least among companies who have no organized system of training apprentices.

THE FOUNDRY'S interest, space given editorials concerning these problems are commendable indeed and should bear fruit in bringing about co-operation between educators and foundrymen in developing recognized courses of instruction for both the engineering and trade school student.

Fundamentals of
FOUNDRY PRACTICE

Directions Are Given for Molding Several Typical Castings Including Pulleys, Gears, Ingot Molds and Steam Cylinders

By Ivan Lamoureux

[Interpreted in the Light of American Practice by Pat Dwyer]

Part XII

TO MOLD a curved plate with ribs, shown in Fig. 143, the following operations must be performed in order: Place the pattern with the convex side down on a mold board. This is a special board hollowed out to fit the curvature of the plate. A board of this kind is essential to support a thin wood pattern and is convenient for any kind of a pattern. A heavy wood pattern or a metal pattern may be supported on a plain board by blocks or wedges. Spread a layer of sand about 4 inches thick. Put in a row of long nails or rods especially into the corners. These should be from about 6 to 10 inches long, and spaced about 2 inches apart.

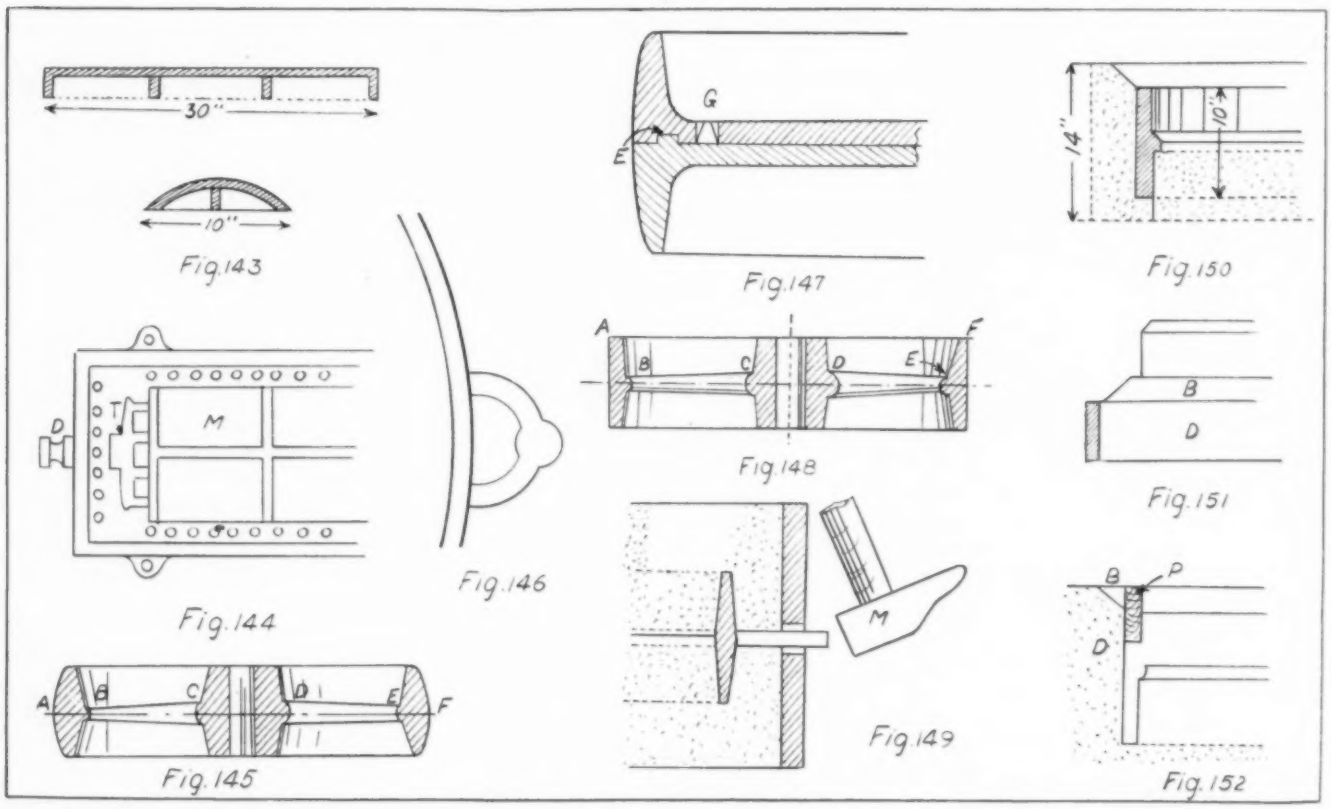
Making the Mold

ALTERNATIVE methods are available for molding almost any casting and while the molder in some instances is free to choose between them, in other instances he is restricted through local conditions over which he has no control. For this reason it is essential that the molder familiarize himself with many methods and thus be prepared either to suggest ideas to the designer or the patternmaker, or, to accept existing pattern and molding equipment and make the best of them.

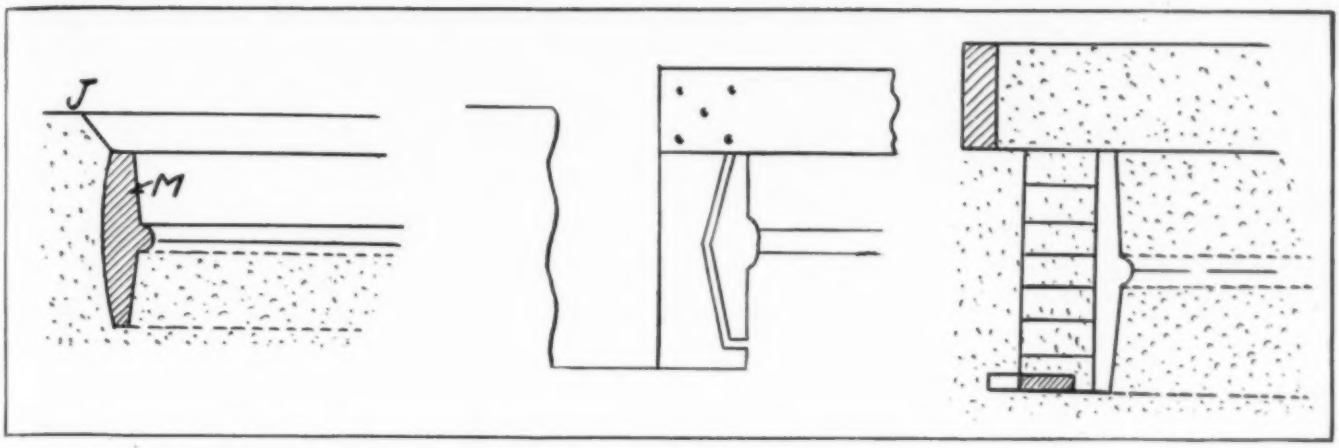
Work the sand with the fingers around the ribs. Refill the hollow of the pattern with sand and tramp it in with the feet.

Put on the drag flask. Fill with sand and ram as usual. Vent the sand with a 3/16-inch diameter wire. Turn the flask over and prepare the joint. Put the cope in place. Set the pouring sprue about 6 inches from the end of the pattern and at the highest point of the arch. Place the riser pin at the opposite end of the pattern and above the intersection of the ribs. Ram the sand in the cope and vent it in the same manner as the drag.

Open the flask. Rap and take out the pattern. Patch the mold if necessary. Prepare the runner and gates.



FIGS. 143 AND 144—METHOD OF GATING AND VENTING A CURVED PLATE. FIGS. 145 TO 152—VARIOUS FEATURES IN THE CONSTRUCTION OF PULLEY PATTERNS AND MOLD



FIGS. 153, 154 AND 155—THREE METHODS OF INCREASING THE FACE WIDTH OF A WHEEL BEYOND THE FACE WIDTH OF THE PATTERN

Spray the mold with gasoline or kerosene and shake graphite over the face. Return the cope to its place on the drag. Clamp the flask.

Several methods are practiced in molding pulleys. In the method shown in Fig. 145 a wood or iron pattern is cut in two parts along the line *a*, *b*, *c*, *d*, *e*, *f*. The two halves of the pattern are matched together by an annular male and female joint and two dowel pins as shown in Fig. 147.

Provide Cross-Bars

With a pattern of this kind the job can be started by placing one half of the pattern joint side down on the mold board. When the drag is rammed and rolled over the joint is perfectly flat.

The cope should have a sufficient number of cross-bars to carry the sand and to reduce the number of gaggers required to a minimum. The draft given to each half pattern facilitates the machining of the casting. It leaves but the strictly necessary amount of excess material for that operation.

Some pulleys are poured through a runner located a few inches beyond the pulley rim connected with gates as shown in Fig. 146. The majority of pulleys are poured through the hub.

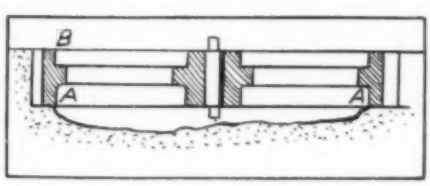


FIG. 158—SAND FIRST IS RAMMED AROUND THE RIM OF THE WHEEL

A riser of the same shape as the pouring gate is arranged on the side diametrically opposite the pouring gate.

Where the diameter of the pulley exceeds 24 inches, the gates can be placed between the arms and directed toward the rim. A vent through the cope over the center core is not advisable. Iron may enter and cause the core to blow. One or two vent holes through the core print in the drag will be sufficient.

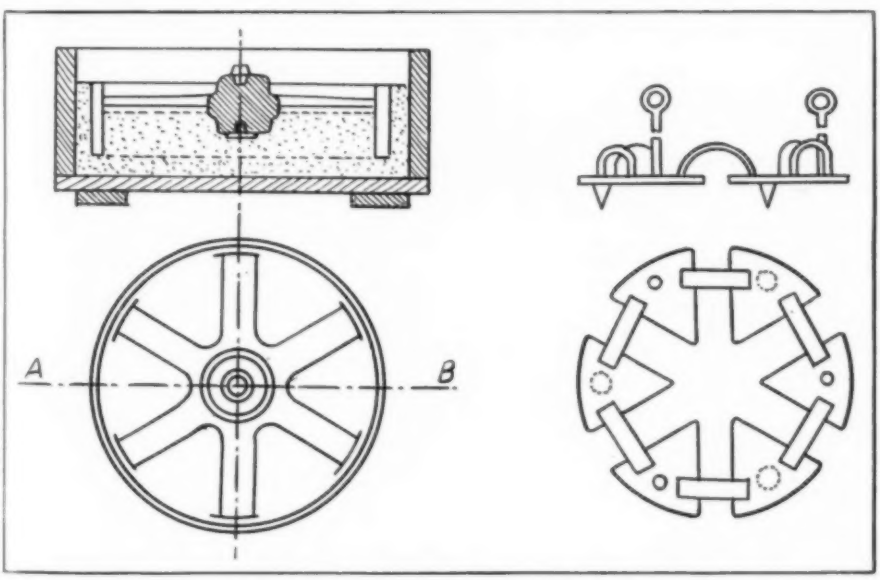
The usual type of one piece pattern with face drafted from top to bottom is shown in Fig. 148. The entire pulley is molded in the drag with the exception of that part bounded by the letters *a*, *b*, *c*, *d*, *e*, *f*, which is lifted in the cope.

Iron patterns, usually are employed for molding pulleys. A wide variety of wooden hubs permits many adjustments in diameter, length and size of bore. In many instances both arms and hubs are made of wood and are detachable. With this equipment many different size pulleys may be molded from a single pattern ring.

After the cope is removed, the pattern readily may be rapped with a hammer and wooden block. Particularly wide face patterns usually are rapped at least once all around before the last course of sand is rammed. Where the arms are flat, the joint line will appear as indicated in Fig. 148. Where the arms are round or elliptical in cross section, the joint line will follow the center of the arm. With the foregoing patterns equipment any kind of a standard flask may be used. The outside and top joint from the rim to the edge of the flask is flat.

The face of some machined iron pulley patterns is drafted both ways from the center. The pattern is all in one piece and the joint in such case follows the center line of the spokes and of the rim as shown in Fig. 145. This method is particularly applicable in the molding of pulleys less than seven inches in width on the face over 24 inches diameter. One-half of the pattern projects above the joint and into the cope, which should be barred in a manner to carry the sand with the minmum number of gaggers.

One way to rap a pulley pattern before lifting the cope is illustrated in



FIGS. 156 AND 157—PATTERN AND ARBOR REQUIRED IN MAKING A PULLEY MOLD IN GREEN SAND

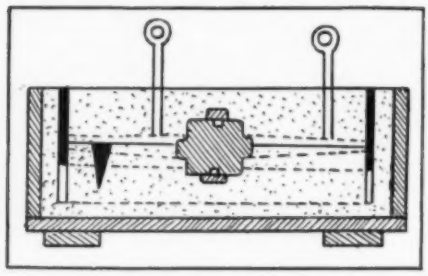


FIG. 159—ILLUSTRATES MANNER OF EMPLOYING LIFTING ARBOR IN PULLEY MOLD

Fig. 149. An iron bar is introduced into an opening at the joint provided for the purpose. The outer end of the bar is struck with a hammer and the force of the blow is transmitted to the entire pattern. The process is repeated on all four sides of the flask. By applying this method with proper discretion a skilled molder can secure a clean lift on the cope, that is a cope in which all the sand is intact.

With slight manipulation a mold may be made wider or narrower than the pattern. To obtain, for example, a pulley 14 inches on the face from a pattern 10 inches wide and with the arms still in the center, one can proceed as follows: Block the pattern in place four inches below the joint of the flask and cover the pattern with sand. Ram the sand on the outside of the pattern up to the top of the rim, and on the inside up to the level of the spokes. Rap the pattern slightly. Raise the pattern two inches and place 2-inch blocks under the arms to hold the pattern in place until sand has been packed around it inside and outside. The blocks can be removed at this stage or allowed to remain in place until the pattern is removed later.

Build Up Joint

Ram sand on the outside up to the joint of the drag and make a sloping parting down to the edge of the pattern as shown in Fig. 150. Make the usual flat joint at the arms and cover with parting sand. After the cope has been rammed and turned over by the slings, remove the bank *B* on the cope, Fig. 151, with a short straights edge. Lift the pattern until the top edge is above the joint. Then pack sand into the triangular space *B*, Figs. 150 and 152. This sand is slicked off flush with the joint and the pattern is again rapped slightly and removed. Under certain conditons a short segment, Fig. 157, is employed while building up the joint.

To secure a pulley of 14-inch width from a double drafted pattern 10 inches wide on the face the following method may be used: Ram sand inside the pattern up to the arms and outside to a joint level 2 inches above the top of the pattern. A slanting parting is made as in the first example and a cope is rammed and lifted off. Dig a trench about 8 inches wide and 14 inches deep all around the pattern to uncover the rim on the outside. With a strickle following the contour of the pulley face dress a joint 2 inches below the lower edge of the pulley. Lift out the pattern and finish the mold. Make the outside of the rim with a loam ring 14 inches in height as in Fig 155.

Pulleys with flanges and pulleys with grooves generally are molded in the same manner as a pulley that is larger than the pattern, that is, with a loam or sand ring for the outside, but in such a case the outside of the rim has no draft. A sheave pattern is divided horizontally on the center line. A double flange, straight face pulley, is constructed with one (the bottom) flange loose and the mold is made in a three-part flask, drag, cheek and cope. The cheek is reinforced with a lifting ring, a row of long nails or a number of short bars to carry the body of overhanging sand. Small sheaves usually are molded in two-part flasks that are rolled over twice. In many instances a dry sand core, either in one, or in several pieces, is employed to form the groove.

Molding Gear Castings

To mold gears with wooden patterns, it is necessary to proceed rapidly to prevent the moisture in the sand from warping the wood, especially if the diameter is greater than 28 inches. Throw the sand in between the tooth spaces but do not ram it. Rap the pattern rim before ramming sand around the hub and arms strike lightly against *a*, Fig. 158, to detach the pattern well from the mold. Finish as with an ordinary pulley. After removing the cope, rap the pattern by light blows against *b* over the whole inside of the rim.

If the pattern was rapped strongly through the hub, a bad job would be obtained. The sand between the teeth would become loose and collapse during or after the drawing of the pattern. Ordinarily gears are poured through a single pop gate on the hub or by gates on the joint between two arms and directed toward the hub, so that the iron flows uniformly into the teeth.

Some foundries have equipment which enables them to make pulleys of all widths and of any specified diameter. A number of patterns are available for rims. They are well finished and drafted. Hub and arm patterns are adjustable and interchangeable. Cast iron armatures or crabs, as shown in Fig. 157, are employed to facilitate molding.

American Method

Suppose we require to mold in green sand, a pulley of 32 inches diameter and 12 inches wide from a rim pattern 8 inches wide, Fig. 156. Place the ring pattern level in the floor or in a flask. Tamp the sand inside and outside. Make a joint on the inside within 2 inches of the top edge. Bed in the arm and hub pattern. Rap the rim pattern lightly. Raise it 6 inches above the joint of the arms. Ram the outside suitable and make a flat joint as in Fig. 156.

Place the core iron or crab, Fig. 157 consisting of 6 cast iron sectors tied together by cast iron or steel loops, permitting the passing of the arms. Three of these sectors carry points on their undersides to guide the core into place. Three other sectors have tapped holes in the center to receive the threaded lifters required for lifting the core. Coat the edges

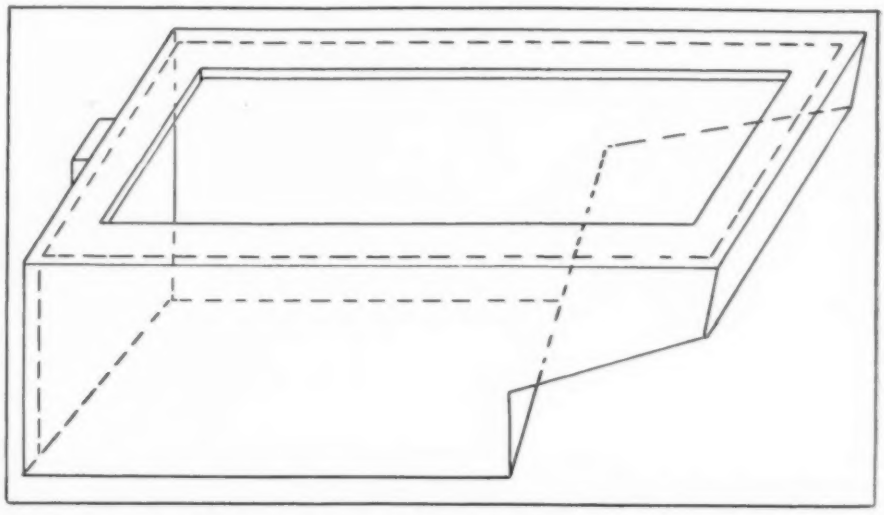


FIG. 160—PERSPECTIVE VIEW OF THE CASTING SHOWN IN SECTION IN FIG. 161

of the core iron with clay wash. Rap the plate down to a bearing on the joint between the arms. Insert the lifters in the threaded holes. Ram the sand up to the top of the pattern on the inside as in Fig. 159. Scrape the sand flat with a straight edge inside and outside. Remove the lifters and cover each opening with a piece of card board or thin sheet metal. In some instances short lifters are employed. They do not project above the joint and therefore are not taken out.

Put on the cope of the flask. Set the pouring gate stick on the outside of the rim and the riser right over the hub. After removing the cope, place one or more identifying marks in the sand inside and outside the rim, the rim at the junction with the arms and if it is not moved, it will show up when the pulley is machined. Pulleys in American foundries almost invariably are poured through the hub.

Instead of a cope, a round iron plate is bolted down to the crab between the arms. The core is lifted by this plate. Later the weights are wedged above it before the casting is poured.

The great majority of cast iron pulleys now are made on a pattern stripping molding machine in special flasks.

One method of molding a large casting in dry sand is shown in Fig. 161. The pattern is closed at one end and three sides. It is open on the bottom *g f*. The corebox is designed to make the core in one piece.

The two foregoing methods are based on the assumption that the core and the mold are made separately and assembled afterward. In some instances this is necessary and in other instances it may be advisable for lack of oven accommodation, suitable flasks or other reasons. Where conditions are favorable, mold and core may be formed at the same time, directly from the pattern and without incurring the expense of a corebox. The only extra equipment needed is a small corebox for the square core *h, i*, at one end. This method also does away with all the lifting and fitting involved in handling a core that is made and dried by itself.

The pattern with one slight exception is an exact replica of the casting and is bedded down level in a pit in the floor, or in a flask, if one is available. The one exception is that instead of a closed top side, the pattern presents an open top as shown in Fig. 160. After arranging a coke bed in the bottom of the pit or flask, the pattern is adjusted level. Sand is rammed around it inside and outside up to the top. Short rods are placed in the inside corners at each course of ramming to reinforce the sand after the pattern has been withdrawn. Sand under the top frame is not rammed as hard as the remainder. Sand either is scraped off flush with the top face of the pattern, or, it is scraped flush with the lower edge of the wood forming the top frame. In the second instance, a number of flat boards are placed on the sand and the cope impression is taken from them.

After the cope is removed the core is vented by driving a wire down to the coke. Usually the bed coke is supplemented to extend well up into the core. The pattern then is removed, leaving molding and core in their proper relative position. The only objection to this method is that

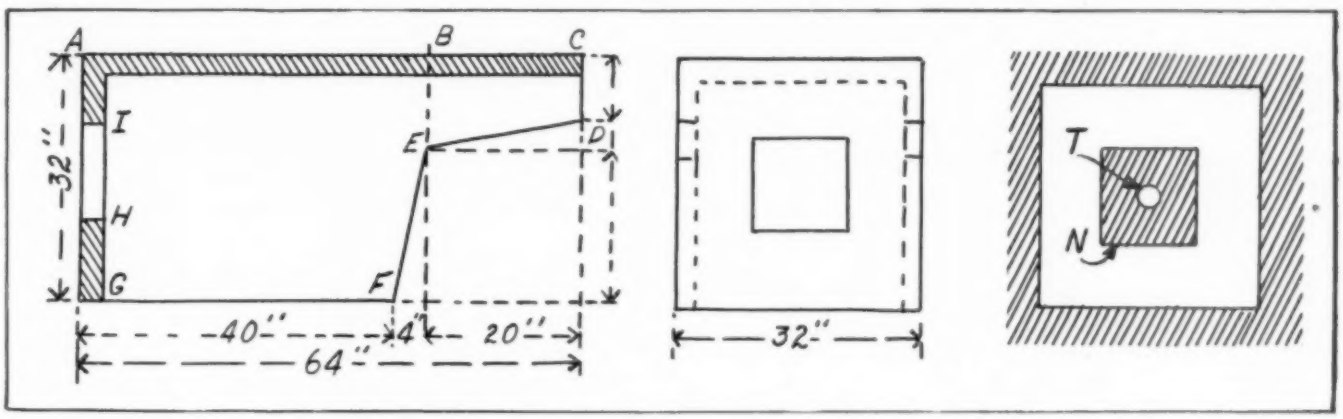


FIG. 161—LONGITUDINAL SECTION AND END VIEW OF INGOT MOLD CASTING. FIG. 162—IN THIS TYPICAL MOLD *N* IS THE CORE AND *T* IS THE PASSAGE FOR THE VENT

to serve as a general guide in replacing the body of sand over the arms. Rap the pattern and draw it out without difficulty owing to the draft. The thickness at the bottom is ¼-inch and ½-inch at the top. Put the lifters back in place. Lift out the core. Owing to the exact form of the core iron, no dropping off will occur.

Brush graphite over the face and arms. Remove the arms and hub from the drag. Shake graphite over the drag part of the mold. Set the small central core and replace the large one using the guide lines traced before drawing the pattern The three pins on the core iron guide the core accurately into place. The cope is replaced and the mold is weighed or clamped.

In many American shops no cope is placed on a pulley mold. The hub is covered but the rim is left open. The principal advantage of this method is that a man can watch the iron rising in the rim. If slag or dirt shows a tendency to accumulate at any point and refuse to rise, he can touch it with a small rod and cause it to float to the top. Dirt shows a marked tendency to accumulate in

To mold the pattern it is necessary to: Dig a pit 5 x 8 feet, 40 inches deep. Arrange a bed of screened floor sand to a thickness of 6 inches. Put a layer of facing sand, to a thickness of 2 inches Rap the pattern down with hammer blows. Weight the pattern with 1000 pounds to hold it in place.

Ram the sand in regular courses all around the pattern up to the joint *a, b, c*. Ram the cope. Withdraw the pattern, finish the mold and dry it.

To mold the core, it is necessary to: Place a core iron with wings in the bottom of the corebox. The corebox is lined with facing or core sand and the interior is filled with coke. Place a row of long rods to carry the over hanging sand in *b, c, d, e*. Arrange for escape of the vent through the opening *h, i*.

In another method proceed as follows: Prepare a level bed. Ram sand around the pattern as in the first instance. Make up the core in three sections: One for *h i*, one for *a b f g* and one for *b c d e*. secure the cores by cast iron plates buried in the sand, and with tail prints.

the walls of the mold and core cannot be covered with blacking.

Where blacking is an essential feature, the same pattern equipment will serve. The only additional equipment required is a lifting plate to place in the bottom of the mold. After the cope has been removed, this plate is employed to lift the core out of the mold. Both core and mold are blacked and dried independently and then reassembled.

For the molding of an electric motor frame, molders follow either one or the other of the following methods, though only the second is to be recommended.

In the first method the pattern is molded flat in such a way as to place one flange on the bottom and one on top. A central and a bottom core are made up in coreboxes. The mold is made in a three part flask. The pattern is cut in two parts and one of the flanges is removable.

This method presents serious inconveniences because it favors an accumulation of slag in the upper flange. It causes heavy fins around the holes. It necessitates a core for hollowing out the base.

The second method differs from the preceding one in that the molder makes up his mold so as to place the flanges on the sides of the mold. He uses a pattern parted along a diameter parallel to the base of the foot, the foot being hollowed and removable. He molds in three flasks and prepares the first joint following the section of the pattern at the cylindrical part and a second joint at the level of the foot. Advantages of this second method include the fact that it provides perfectly sound flanges, prevents fins around the holes, eliminates the use of a core for the foot, and simplifies molding.

Molds a Cylinder

To mold a single cylinder with a pattern, the molder should have available a pattern made up of two halves, matched together with dowel pins; four core-boxes, namely: A box for a semi-cylindrical core, with recesses for steam port cores, a box for the steam port cores, a box for the exhaust core, a box for the valve port core.

The mold is made flat in a two part flask, cope and drag. The pouring is done through a long gate attached to the two flanges. The flat risers are taken off the flanges and a cylindrical riser is placed below the boss for the steam entry, to clear and clean the mold. The cores are molded from a mixture of 15 parts of clean silica sand and 1 part of flour, wetted with molasses diluted with water in the proportion of 1 to 12.

After the mold is finished, one can either place the four cores separately in the cylinder, or first assemble them on a suitable bench or table where they may be fastened together and then lowered into the mold in one piece.

The core is the most delicate part of the mold. Whereas the mold *M* Fig. 162, is prepared in a flask which strengthens it by supporting the sand, the core *N*, must in itself have sufficient cohesion to be handled without great danger and which enables it to stand up at the time of pouring.

In a mold the escape of the gases is facilitated by their removal through the walls of the mold. In a core the gases formed against the surface of the core must open for themselves a passage through the pores of the sand to pass out through the vent *T*. The pores of the sand become more and more contracted as the center of the core is approached.

The intense heat developed in the mold at the time of pouring reacts strongly on the core all parts of which (especially small cores) become incandescent. Thus the cores must be capable of resisting more heat than the molds.

Molybdenum Improves Gray Iron

By J. Kent Smith

MOLYBDENUM rapidly is proving to be an excellent alloy for the improvement of the physical properties of cast iron. Although no detailed tests have been issued as yet, the following information may be of interest. Improvement in strength, *density*, as evidenced by grain size, absence of blow holes, freedom from hard spots, excellent machinability and minimization of foundry difficulties is noted in cast iron to which the correct addition of molybdenum has been made. This addition generally amounts to 0.35 per cent molybdenum or 7 pounds to the short ton of clean, hot cast iron containing 3 to 3.25 per cent total carbon and 1.9 to 2.1 per cent silicon. These proportions are susceptible to modification depending on the type of work and the desired results. This addition of molybdenum to cast iron produces a metal better resistant to wear and also withstands atmospheric corrosion to a much better degree than does ordinary cast iron.

Naturally, better results are obtained by a larger addition of molybdenum than that previously mentioned. This is shown in the accompanying table, which has been compiled from data obtained by the author during investigations for the Climax Molybdenum Co., New York. Practical experience gained from the examination of thousands of different castings suggests the following probable reasons for the improvement of cast iron by molybdenum additions: Molybdenum enters into a solid solution in the carbonless portion of the iron whether structurally free or a constituent of the pearlite, and thus strengthens the iron directly. Furthermore, by reason of this direct action the grain refining effect probably is produced.

By the sorbitizing effect of molybdenum on the pearlite content, it further strengthens and toughens the iron. Most important of all and in the first place probably by reason of the solution, its addition to cast iron produces a marked difference upon the graphite content both as to formation and distribution. In a well molybdenized iron of the correct balance, large interfering plates of graphite are absent. The graphite inclusions take

Data on Molybdenum Additions

Nature of test	Plain iron	0.35 Per cent molybdenum	Plain iron	0.80 Per cent molybdenum	Plain iron	1.0 Per cent molybdenum
Transverse strength lbs. per sq. in.	29,000	38,000	28,000	41,000	40,000	56,000
Tensile strength lbs. per sq. in.	29,000	38,000	28,000	41,000	40,000	56,000
Brinell Hardness	198	208	201	213	235	285
Machinability rating based on type of iron	Good	Better	Good	Better	Good	Equally Good

the form of small, hooked plates and balls well distributed throughout the matrix.

As a result of the previously mentioned actions the addition of molybdenum slightly hardens the iron to indentation by the brinell hardness tester. This, however, is not brought about with any decrease in machinability which on the other hand, probably as the result of the altered graphite formation, actually is improved in the final result. Solution of the molybdenum in the *molten* iron bath suppresses the point of volume change in the *liquid* phase. In this respect molybdenum in the author's experience is unique among the elements.

To this definite and proved physical effect the author mainly ascribes the observed fact that castings of molybdenized iron of varying section do not crack in the mold as readily as those of ordinary iron. This feature may make a material difference in determining the actual added cost resulting from molybdenum additions. Data collected from castings used in automotive construction and service are tabulated in the accompanying table. These show the effects of molybdenum additions of 0.35, 0.80 and 1.0 per cent. In further tests with a molybdenum addition of 2 per cent, a foundry iron was obtained that showed a transverse of 6900 pounds per square inch, a tensile strength of 58,500 pounds per square inch and a brinell hardness number of 302. The tests were conducted on the regular arbitration test bar and the iron was machined easily.

Molybdenizing of cast iron is radically different from the molybdenizing of steel. In both it is essential to insure complete solubility and miscibility, but is done with difficulty in the case of iron. Where the cupola is employed as the melting agent, molybdenum additions must be made in the ladle. In such case the best method and in the author's opinion the only successful method to add molybdenum is by the use of a molybdenum iron alloy which is specially prepared for use in cast iron because of its solubility and absence of segregation effects. This alloy contains from 60 to 65 per cent molybdenum and sells for about $1.10 a pound of molybdenum contained. When iron is melted in the electric or air furnace, it is permissible to use calcium molybdate which adds molybdenum to the metal through the medium of the slag. Calcium molybdate sells for about 95 cents a pound of molybdenum contained. Molybdenum iron alloy may be obtained broken up for ladle use. The iron bath molybdenized should range from 120 pounds upward.

Welds Aluminum Castings

WELDING of aluminum castings requires expert operators and careful preparations. Before the job is begun, the piece usually is preheated in a furnace, the temperature being raised slowly to the proper heat. The piece also must be supported carefully during the preheating period. However, experienced aluminum welders frequently dispense with the usual heating furnace and handle many jobs, both simple and complicated, with local preheating, using an oil burner for the purpose.

The illustration shows a welder at work on the lid of a rotary bottling machine 56 inches in diameter and ¾-inch thick. It has a crack about 20 inches long from one edge toward the center. The circular shape of the casting made the expansion problem fairly easy. It was complicated somewhat by a manhole opening at one edge through which the crack passed, and by the fact that where the reinforcing ribs passed through the center bearing, metal was heavier than elsewhere.

The lid had a crown of about 3 inches which increased the difficulty of penetrating the full thickness without forming projections of metal on the inside. It was necessary to avoid that as such an occurrence would necessitate extensive finishing. Although preheating the entire casting in a furnace was unnecessary, it would be desirable to heat it locally along the crack, slightly ahead of the welding flame, so that the welding heat would not bring on a too sudden rise in temperature and cause further cracking.

Briefly the procedure was as follows: A steel plate was formed to fit the inside of the lid, and clamped to it along the crack. The whole casting was fastened to a flat surface and the two sides of the break were aligned at the open end by a steel strap clamped in position. Then the opening was "V"d carefully.

First, the whole length of the break was heated slightly with an oil burner. Welding was started at the inner end of the break, with the flame preheating the aluminum a few inches ahead of the welding flame. The preheating opened the crack to the limit of expansion. To insure a sound weld, both a puddling rod and cast aluminum flux were used. The puddling rod is used to remove oxide from the surface of the molten weld metal.

A covering made of asbestos paper was placed on sections of the break as were finished. Care was taken all during the work to keep drafts of cool air from the weld. The whole break 40 inches long was welded in about an hour and a half.

A Crack 20 Inches Long Was Welded in an Hour and a Half

SAND CONTROL
Increases Economy in the Foundry

Results Obtained from Laboratory Tests Give Data Which Are Applied to Control Sand in Molding System

By O. E. J. Abrahamson

TO MIX molding sands whose individual characteristics and analyses were known in certain definite proportions and to be able to foretell what permeability, bond, etc., the mixture would possess in the same manner as it is possible to mix different analysis pig iron, cast scrap and steel and predict with a certain amount of accuracy the qualities that the gray iron from such a mixture would have, heretofore has been impossible. However, as the knowledge of molding sands, the laws that govern their characteristics depending on percentage of bond, size and number of grains, has become more definite, it has resulted in the establishment of laws and rules which makes it possible to take any number of molding sands and by a few simple calculations, predict with a relatively small percentage of error, the properties that any mixture of these sands will have.

For example, a sand was desired which in a continuous sand system, with proper mixing devices such as mullers and beaters, will show a bond of 12.0 per cent and a permeability of 20 at one per cent below the optimum water content and with a seacoal content of 6.0 per cent by weight. Since the sand constitutes 94 per cent of the mixture it follows that the sand proper should contain 12.8 per cent bond. Further, since 6 per cent seacoal by weight (having 15 per cent or less on the 200 mesh) reduces the permeability of the sand at practically the same rate as fine pan material as shown in Figs. 22 and 23 and in Table XI, or about 30 per cent, we have:

$$X - .3X = 20 \text{ or } X = 28.6$$

That value is then the permeability of the sand without the seacoal at one per cent moisture below the optimum water content. The average permeability for this sand with 12.8 per cent bond is then obtained by dividing 28.6 by the factor for this bond content as shown on Fig. 24 or Table XI to be equal to 1.52. Therefore 28.6 divided by 1.52 is equal to 18.8 which is the average permeability for the sand desired.

The permeability factor for this sand is found by consulting Fig. 23 or Table XI to be 2.4. Therefore, $18.8 \times 2.4 = 45.1$, which is the permeability used in obtaining the average grain size (exclusive of bond and fine pan material) from Fig. 3 by following 54.1 horizontally until the vertical line corresponding to 12.8 per cent bond is reached. It is found that the average grain size exclusive of bond and fine pan material is equal to 0.0054 inch.

From Table IX it is found that one gram of a sand free from bond having this average grain diameter contains 284,000 grains (round numbers). However, the sand desired has a bond of 12.8 per cent and therefore an equal amount of sub-pan or a total of 25.6 per cent, and

$$(100 - 25.6) \times 284{,}000 = 211{,}000$$

or one gram of the sand desired has

Interprets Results

AFTER the laboratory methods are established, the next step is to interpret and apply the results found in the laboratory. Therefore in this article the author gives several examples of the interpretation and application of laboratory results in three large foundries. This article is the fourth of a series on sand control. Other parts of the series have appeared in the March 15, April 15 and May 15 issues of THE FOUNDRY.

Table XIII

Cost of Mixtures with Same Bond Content

Assuming that 80 pounds per batch of facing will keep the supply of sand in the units intact and that 660 batches are used per shift, there will be a total consumption of 52,800 pounds per shift or 105,600 pounds per day.

	Bond per cent	Mixture								Cost delivered per ton
		Per cent	Pounds	Per cent	Pounds	Per cent	Pounds	Per cent	Pounds	
New mold, sand, present	9.5	45.0	47,500	.....	.....	31.2	32,950	30.0	31,700	$1.98
New mold, sand, AA	13.3	.....	.....	100.0	105,600	.....	.....	.....	.....	$3.00
Special clay	35.0	25.0	26,400	.....	.....	.....	.....	.....	.....	$11.90
Surface clay "O", powd.	45.0	.....	.....	.....	.....	21.9	23,150	.....	.....	$7.80
Surface clay, "O", raw*	38.2	.....	.....	.....	.....	.....	.....	26.2	27,650	$5.20
Cleaning room sand	1.0	30.0	31,700	.....	.....	46.9	49,500	43.8	46,250	.....
Total bond of mix per cent	.....	13.3	.....	13.3	.....	13.3	.....	13.3	.....	.....
Total cost of mix per day	.....	.....	$206.50	.....	$158.20	.....	$122.95	.....	$103.30	.....

*Contains about 15 per cent water.

The true bond in special clay will vary considerable from as low as 22.0 per cent up to and seldom exceeding 35 per cent.

The true bond in "O" surface clay varies from 40 to 65 per cent; will average better than 45 per cent.

211,000 grains exclusive of bond and fine pan material. The procedure to be followed to obtain this sand from three available sands is shown in Table XIV.

However, it must be born in mind that permeabilities and bond as calculated depend in no small measure on the mixing and treatment that the sand receives and are the values that the mixture will have if laboratory mixed and tested.

Each and every foundry, due to its physical condition, the type of casting made and the kind of sand employed—both core sand and molding sand—will have different sand conditions to be met and equilibriums to be calculated and created. The length of time that exists between pouring and shaking out has a great influence on the returned sand since the longer the period is, the more burnt core sand will be lost from the casting into the molding sand and the longer the casting remains in the mold the more bond in the sand will be destroyed, due to the heating up of the sand. These conditions and a great many others will have to be studied along the lines exemplified by the following observations and studies made in three different foundries.

In foundry No. 1, which is of the continuous type producing daily 5000 light castings weighing 20 pounds each, all the sand is passed through one sand handling system and since this system is equipped with mullers, beaters and storage tanks the necessity for a special facing sand has been eliminated. That is, all the sand is put in condition to serve both as facing and backing sand.

At the time a study of the sand problem at this plant was made, it was found that because of the employment of an improper new sand, the molding sand that had to be taken out of the system daily to keep the sand in a fairly good condition amounted to more than 8 tons with a consequently high consumption of both new sand and seacoal as well as an added labor cost.

A thorough study of existing conditions in this plant, sands available at low costs, etc., made it possible to create an economy in sand consumption of more than 5 tons daily and further that by employing a surface clay, additional reductions in sand consumption could be obtained. The calculations involved in that study were as follows:

The average amount of molding sand carried out on each of the 5000 castings weighing 20 pounds each was 1 pound, or a total of 5000 pounds of sand. The average amount of molding sand and burnt core sand carried out on the casting conveyor per day amounted to 68 wheelbarrows at 300 pounds each or 20,000 pounds in round numbers. The average amount of burnt core sand that dropped out of the castings into the molding sand and onto the casting conveyor amounted to 1.75 pounds per casting or 8750 pounds. Of that amount 0.5-pound per casting or 2500 pounds ran into the molding sand conveyor and 1.25-pound per casting, or 6250 pounds ran out on the casting conveyor.

Therefore, the amount of sand lost on the casting conveyor was 20,000 minus 6250 or 13,750 pounds. The daily molding sand loss was 13,750 plus 5000 (taken out on castings) or 18,750 pounds. However, that loss was offset by the core sand that dropped into the molding sand or 2500 pounds. Consequently the daily sand loss was 16,250 pounds.

Therefore, a sufficient amount of sand should be added to meet that loss and the sand should contain sufficient bond to offset the reduction in bond caused by the burnt core sand that runs into the molding sand, as well as the loss of bond due to the high temperature that part of the sand is exposed to.

The desired bond in the sand system was from 12 to 14 per cent and to obtain that condition it was necessary to add new sand to the sand in the system. The sand in the system from the data previously given

Table XV

Program No. 1 for Foundry No. 3

(Based on 2500 castings per day)

Since varying amounts of sand are taken from the continuous unit daily to serve both as facing and backing sand for a number of floor units, the amount of sand carried out on the castings is not readily determined.

Molding sand mixture,
X-sand 33 lbs. (3 shovels @ 11 lbs.), 60.0 per cent
Y-sand 22 lbs. (2 shovels @ 11 lbs.), 40 per cent

55 pounds (5 shovels) of new sand added to each batch, 215 batches per day.....
.....215 x 55 = 11,825 pounds per day

Burnt core sand, A, lost into molding sand, about 2.4 pounds per casting or a total of
.....2500 x 2.4 = 6000 pounds per day

X-sand, 60 per cent @ 11.0 per cent bond
Y-sand, 40 per cent @ 20.0 per cent bond } average 16.4 per cent bond.

X-sand, 60 per cent @ 1.0 per cent on 35-mesh sieve
Y-sand, 40 per cent @ 15.0 per cent on 35-mesh sieve } avg. 6.6 per cent on 35-mesh sieve.

Total new sand added to the system 11,825 minus 7 per cent water = 11,000 pounds per day.

Therefore;
New molding sand 11,000 pounds, 64.7 per cent.
Burnt core sand, A, 6000 pounds, 35.3 per cent.

New sand, 64.7 per cent @ 16.4 per cent bond
Burnt core sand, 35.3 per cent @ 0.0 per cent bond } Average 10.6 per cent bond, which is the bond of the sand less the burning out losses. While this mixture was used the sand averaged about 10.0 per cent bond.

New sand, 64.7 per cent @ 6.6 per cent on 35-mesh sieve
Burnt core sand, 35.3 per cent @ 42.0 per cent on 35-mesh sieve } Avg. 19.1 per cent on 35-mesh sieve.

Seacoal requirements equal to 8.0 per cent of 11,000 plus 6000 or 1360 pounds per day or a little less than 6.5 pounds per batch of sand.

Table XIV

Calculating the Sand Mixture

	No.	General description of the sands	Average permeability	Bond per cent	Average grain size exclusive of bond and fine pan material inch	Number of grains per gram exclusive of bond and fine pan material
	1	Very open, low bond sand (No. 22)	100.5	1.5	0.0066	152,300
Available sands	2	Med. open, med. bond sand (No. 9)	9.8	16.3	0.0049	258,000
	3	Tight, heavy sand (No. 8)	3.9	21.1	0.0047	250,000
Desired sand			18.8	12.8	0.0054	211,000

The first glance at the available sands suggests a mixture of about one-third of each. However, preliminary calculations shows that the bond then is a little too high, so after trying a few combinations the following mixtures were developed:

	Bond		Grains
No. 1 40.5x 1.5 =	0.61 ; 40.5x152,300 =		61,700
No. 2 7.5x16.3 =	1.22 ; 7.5x258,000 =		19,300
No. 3 52.0x21.1 =	10.97 ; 52.0x250,000 =		130,000
Average.....	12.80		211,000

Table XVI

Program No. 2 for Foundry No. 3

(Based on 2500 castings per day)

Additional equipment. Wooden plow on belt from mullers.

Molding sand mixture.

Z-sand	650 pounds (on dry basis)	36.0 per cent
Surface clay (raw)	250 pounds (on dry basis)	14.0 per cent
Shake-out sand	900 pounds (on dry basis)	50.0 per cent
	1800 pounds per batch.	

Prepared sand.

7 batches @ 1800 pounds = 2,600 pounds plus 7 per cent moisture = 13,482 pounds per day.

55 pounds (5 shovels) of prepared sand is added to each batch of sand, 215 batches per day × 55 = 11,825 pounds per day.

New sand and clay equal to 50 per cent of 11,825 pounds = 5913 pounds per day.

Burnt core sand, B, lost into molding sand @ 2.0 pounds per casting, 2500, 2500 × 2.0 = 5000 pounds per day.

Z-sand, 36.0 per cent @ 12.0 per cent bond
Surface clay, 14.0 per cent @ 52.5 per cent bond
Shake-out sand, 50.0 per cent @ 11.5 per cent bond
} avg. 17.42 per cent bond.

Z-sand, 36.0 per cent @ 1.0 per cent on 35-mesh sieve
Surface clay 14.0 per cent @ 1.0 per cent on 35-mesh sieve
Shake-out sand, 50.0 per cent @ 8.5 per cent on 35-mesh sieve
} Avg. 4.75.

Prepared sand, 11,825 pounds — 7.0 per cent moist. = 11,000 pounds } 68.7 per cent
Burnt core sand, B, = 5000 pounds } 31.3 per cent

Prepared sand, 68.7 per cent @ 17.42 per cent bond
Burnt core sand, B, 31.3 per cent @ 0.00 per cent bond
} avg. 11.97 per cent bond, which is the bond of the sand less the burning out losses.

Prepared sand, 68.7 per cent @ 4.75 per cent on 35-mesh sieve
Burnt core sand B, 31.3 per cent @ 17.00 per cent on 35-mesh sieve
} avg. 8.58 per cent.

Seacoal requirements equal to 8.0 per cent of 5913 pounds minus 173 (7 per cent moisture) plus 5000 or 840 pounds per day or a little less than 4.0 pounds per batch.

showed that it was composed of 68.75 per cent molding sand with a bond content of 12 per cent, and 31.25 per cent burnt core sand with no bond. The average bond of all the sand then is 8.25 per cent.

The new sand which was to be added contained 22 per cent bond and calculations showed that by using 6800 pounds of new sand containing 1495 pounds of bond, and 9450 pounds of conveyor sand containing 780 pounds of bond, that the percentage of bond would be 14 per cent (16,250/2275). However, each day 2500 pounds of burnt core sand with no bond was added to the 16,250 pounds of sand in the system. Therefore, the total sand contained was 18,750 pounds with 2275 pounds of bond or an average bond of 12.1 per cent. The percentage of core sand that ultimately was contained in the heap sand was 31.25 per cent of 9450 (amount of conveyor sand) plus 2500 (amount dropped from castings) or 5453 pounds which in round numbers was 29 per cent of the total sand.

After making some changes in the system it was estimated that the total amount of sand lost on the conveyor belt should not exceed 12,500 pounds. Since the sand contained 6250 pounds of burnt core sand, the mixture consisted of 50 per cent molding sand and 50 per cent core sand. Consequently, the mixture recommended was composed of 1850 pounds of surface clay containing 45 per cent bond or 833 pounds of bond material; 1900 pounds of new sand containing 12 per cent bond or 228 pounds of bond material, and 5000 pounds of conveyor sand containing 6 per cent bond or 300 pounds of bond material. The total sand mixture was 8750 pounds with 1361 pounds of bond material or a bond content of 15.5 per cent.

To the 8750 pounds of sand, 2500 pounds of burnt core sand was added daily from the castings making a total of 11,250 pounds. Since the burnt core sand contained no bond, the average bond of the whole was 12.1 per cent. The 11,250 pounds of sand was distributed as follows: The castings took out 5000 pounds and the conveyor carried out 6250 pounds. The percentage of core sand that ultimately was contained in the sand system amounted to 50 per cent of 5000 (casting conveyor sand) plus 2500 (added core sand) or 5000 pounds or 43.5 per cent of the total.

In foundry No. 2, although of the modern and efficient, continuous type producing the same kind of castings as foundry No. 1, a special facing had to be employed, since instead of one or several large sand handling units each molding unit had its own sand handling device without, however sufficient mixing machinery to produce a sand that could be used both as facing and backing sand.

Consequently a certain amount of the backing sand from each unit had to be taken out and transported to the facing sand unit where it was mixed by mullers and beaters with the proper additions of sand (molding and sharp sands), clay, seacoal, etc. The most important feature in connection with the sand problems in that plant was the necessity of having a constant supply of this returned sand in the facing unit so that each batch of facing sand could be mulled a maximum length of time. This condition was particularly important since all the sand required to keep the foundry's sand supply intact both as to amount and quality, was added through the facing.

The new molding sand used in the foundry at the time that study was made was too low in bond to compensate for the burning out of part of the bond and the addition of burnt core sand lost into the molding sand from the castings. Therefore, it had been found necessary to add bond to the facing sand in the form of

Table XVII

Production, Sand Loss and Facing Needs

Facing sand requirements.

Facing per mold pounds	Facing per unit, avg. 150 molds pounds	Total facing for 44 units pounds	No. of batches at 900 pounds	No. of batches per muller (4 mullers)	No. of batches per muller per hour (9.5 hours)	Mixing time in minutes
50	7,500	330,000	367	92	9.7	6.2
60	9,000	396,000	440	110	11.6	5.2
70	10,500	462,000	513	128	13.5	4.5
80	12,000	528,000	587	147	15.5	3.9
90	13,500	594,000	660	165	17.4	3.5
Production, number of castings				16,000	17,000	18,000
Loss of sand, 3.44 pounds per casting				55,000	58,500	61,900
Gain of sand, 0.5 pound burnt core sand per casting				8,000	8,500	9,000
Therefore, total sand to be added to the facing, pounds				47,000	50,000	52,900

Number of batches	Pounds of Sand Per Batch		
367	128	136	144
440	107	114	120
513	92	97	103
587	80	85	90
660	71	76	80

a special clay. This clay, although it served the purpose well had a relatively low percentage of true colloidal bond and had to be used in such amounts that, due to its price, it proved unnecessarily costly.

In Table XVII the production, sand losses and facing sand requirements for this foundry are tabulated and in Table XIII the cost for various sand mixtures having the same amount of bond are shown. In calculating these various costs it has been assumed that the cleaning room sand (burnt core sand and waste molding sand) is free of charge and that the cost of transporting it to the facing unit is equal to that of hauling it to the dump.

In foundry No. 3 producing the same type of casting as No. 1 and No. 2, notwithstanding that it is similar in sand handling and molding with No. 1, a sand problem quite different from either of the two had to be solved. Here, because of a different method of shaking out and due to the fact that the castings remained longer in the molds after being poured, the amount of burnt core sand per casting lost into the molding sand was several times that of the two former. Also in that foundry the storage capacity for mixed sand was considerably less than in the case of foundry No. 1, which, since the sand in the system served both as facing sand and backing sand, meant that the sand had to be mixed and tempered more carefully.

As stated previously considerable burnt core sand was lost into the molding sand, which necessitated the building up of the molding sand with a quite heavily bonded but coarse grained molding sand. Since the core sand also was excessively coarse in texture the tendency of the castings to have an unsatisfactory surface is apparent. To maintain the proper bond and fineness of the sand in the system it was necessary to add large amounts of new sand which resulted in a gain of sand in the system of about three tons daily. An economical solution to the situation was worked out as follows:

1. A better, finer texture core sand was obtained and at less cost than the former core sand.

2. By taking out of the system an amount of sand equal to the daily gain and mixing this sand with a highly colloidal local surface clay and with a local fine texture molding sand and using this mixture as new sand additions, it was possible to reduce the new sand consumption by 50 per cent and the seacoal additions by 38 per cent and at the same time produce better castings both insofar as surface conditions and rejects were concerned. These mixtures were made in the mullers that constituted part of the regular equipment of the sand handling system, at intervals during the day without any interference with these mullers' production schedule.

Tables XV and XVI show more in detail the difference between the two previously described sand programs.

Newark Founders Elect Officers and Directors

W. H. Mantz, for many years secretary of the Newark Foundrymen's association was elected president at a meeting at the Downtown club, Newark, N. J., May 28. Mr. Mantz, who is affiliated with the Atlas Foundry Co., Irvington, N. J., succeeds John L. Carter, Sacks-Barlow Foundries Inc., Newark. H. L. Edinger, Barnett Foundry & Machine Co., Irvington, N. J., was elected vice president and G. W. Hannay, also of the Barnett company, secretary, to succeed Mr. Mantz. J. A. Williamson, Isbell-Porter Co., Newark, will continue as treasurer.

The newly appointed executive committee comprises John L. Carter; G. E. Dieseroth, General Electric Co., Bloomfield, N. J.; P. R. Van Duyne, Meaker Foundry Co., Newark; W. F. Perkins, Worthington Pump & Machinery Corp., Harrison, N. J.; R. B. Flynn, F. L. Smidth Co., Elizabeth, N. J.; V. Vandervoert, Watson Machine Co., Paterson, N. J.; Angus MacDonald, Snead & Co., Jersey City; D. L. Sacks, Sacks-Barlow Foundries Inc., Newark; and F. D. Campbell, Eastern Corp., New York.

J. G. Pearce, director, British Cast Iron Research association, principal speaker at the meeting, described the research activities of his association, stressing cupola practice.

Appoint Representatives

Crane and shovel division of the Link-Belt Co., 300 West Pershing road, Chicago, has appointed the following companies representatives for its products: W-D-M Equipment Co., Box 329, Columbia, S. C.; Myer & Cunningham, 30 Church street, New York; Barzee Equipment Co., 1223 Burnet avenue, Syracuse, N. Y.; S. G. Hawkins Co., 723 Washington avenue, Houston, Tex.; Lewis-Patten Co., San Antonio, Tex.; and West Virginia-Kentucky Hardware & Supply Co., Huntington, W. Va.

Richard F. Straw has been appointed sales manager of the Wright Mfg. Co., Bridgeport, Conn., manufacturers of hoists, trolleys and cranes.

Gives Equipment Orders

The index of gross orders for foundry equipment in April was 122.8 as compared with 164.1 in March, according to a recent report of the Foundry Equipment Manufacturers' association. The index of shipments for April was 274.8 as compared with 194.5 for March. Unfilled orders for April were 244.1 against 411.1 for March. The base is the average monthly shipments for the years 1922-23-24. Comparison by monthly orders as presented by the Foundry Equipment Manufacturers' association follow:

Month	1927	1928	1929	1930
Jan.	180.4	132.7	180.5	160.1
Feb.	198.0	123.6	197.0	196.4
March	131.1	138.6	209.4	164.1
April	130.0	107.7	172.6	122.8
May	134.8	335.6	177.7	.....
June	138.4	149.1	177.3	.....
July	89.9	94.8	219.3	.....
Aug.	106.4	278.0	229.5	.....
Sept.	80.4	170.0	216.3	.....
Oct.	98.0	185.0	245.3	.....
Nov.	95.8	197.8	178.6	.....
Dec.	106.8	166.5	208.0	.....

Wisconsin Group Meets

The final meeting of the Wisconsin Gray Iron Foundry group, before the summer vacation period when no meetings are scheduled, was held at the Schroeder hotel, June 4. The meeting took the form of a general get-together and the chairman called upon the chairmen of the various committees for the annual reports. Professors McCaffery and MacKay spoke on the convention of the American Foundrymen's association in Cleveland, May 12 to 16.

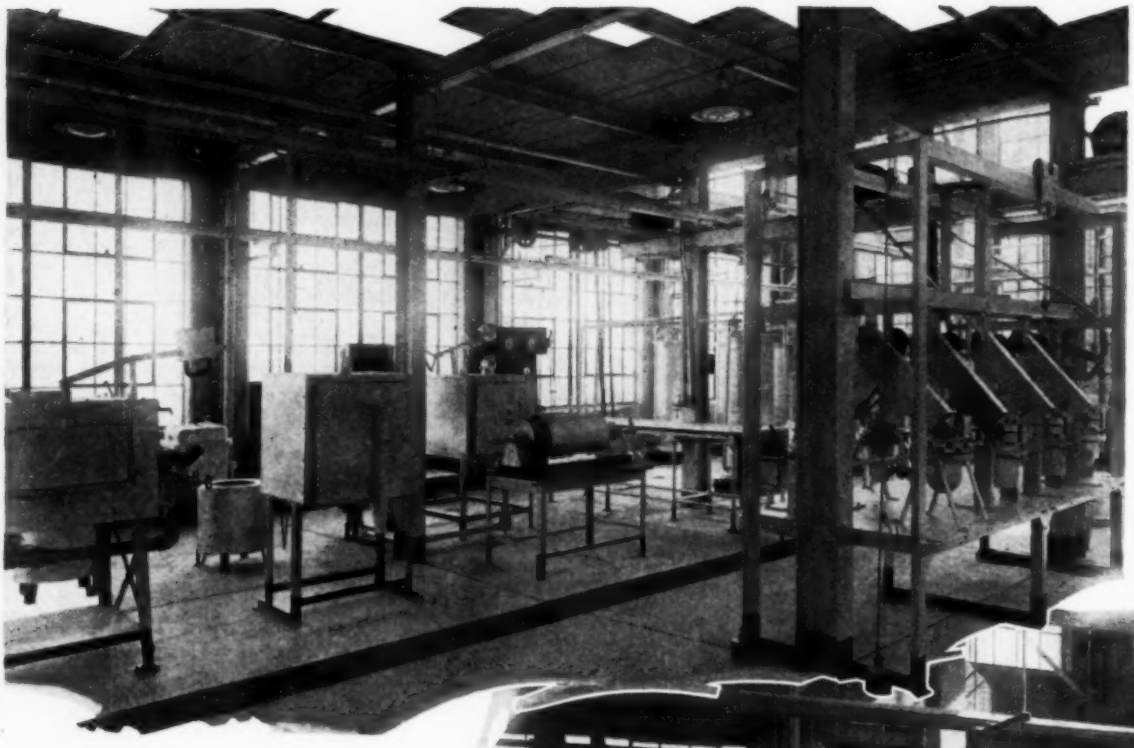
Book Review

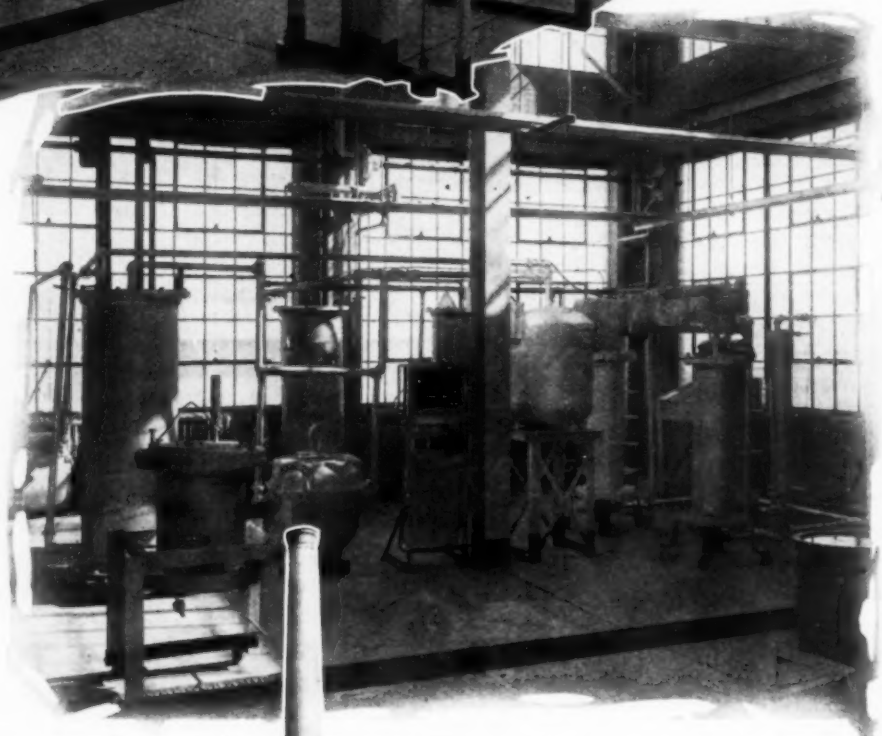
Annual Statistical Report of American Iron and Steel Institute for 1928, cloth, 119 pages, 6 x 9 inches; published by the American Iron and Steel institute, and supplied by THE FOUNDRY for $5, plus 15 cents for postage, and in Europe by Penton Publishing Co., Ltd., Caxton House, London, for 25s, net.

Full and complete statistics of the iron and steel industry of the United States and Canada for 1928 and prior years are included in this annual publication. It also carries foreign statistics for leading countries on iron ore, pig iron, and ferroalloys, steel ingots and castings from 1900 to 1928, as far as available. An analysis of tonnage of iron and steel products exported for 1924 to 1928, inclusive, also is given.

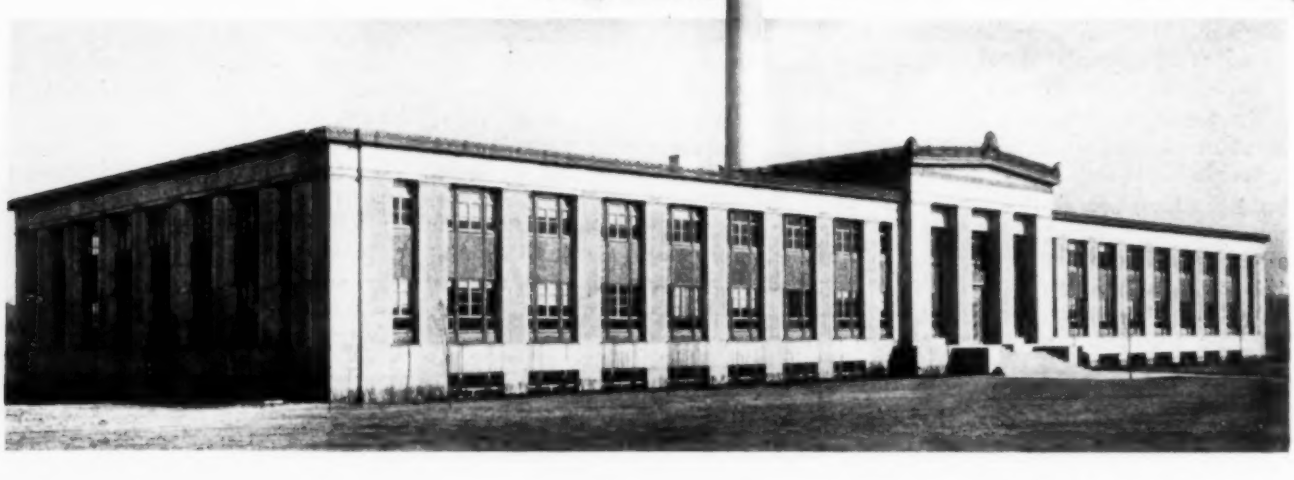
Poetry is the medium of expression used by the International Nickel Co., New York, in a booklet, *Ol' Timer Meets a Specialist.* The "Ol' Timer" tells how he ran into trouble on a foundry job and how the services of the company publishing the booklet came to his rescue.

Opens Laboratory for Aluminum Research





SAID to be the most completely aluminized structure in the world, the new research laboratory of the Aluminum Co. of America at New Kensington, Pa., was opened for inspection recently. Housing 120 research workers under the direction of Dr. H. C. Frary, the building is 275 feet long with 108-foot wings at each end and is the first of two similar units. Illustrations above and at the right show a section of the laboratory devoted to large scale experimentation. Below is shown the facade and approach to the building. Doors, cornices, wall fixtures, pipes, grille work, balustrades, window sills and frames, spandrels and other decorative fixtures all are of aluminum with many castings employed



Questions & Answers on FOUNDRY PRACTICE

GENERAL

Dirty Mold Causes Dross

QUESTION

Many of our castings are dirty when machined, particularly piston ring stock and we shall appreciate your opinion on the probable cause of the trouble. We pour these castings from the bottom into apparently clean molds and with the exception of the defective areas, the castings are clean and solid. The castings usually are 12 inches in length and of various diameters. We use clay for daubing the cupola and we are wondering if this clay is melting and uniting with the iron to form the dirty spots in the castings.

ANSWER

The clay daubing undoubtedly melts but its chance for entering the casting is rather remote. It is of lighter specific gravity than iron and does not flow from the tap hole until the iron has all been drained. Any slag that does enter the ladle floats on top and easily is removed or chilled and held in place before the iron is poured in the mold. If, through gross carelessness some slag does enter the mold it will form a characteristic defective area easily distinguished from defective spots caused by other factors.

In your particular case the dirty spots in the casting are caused by sand either washed in with the stream of metal from a dirty runner, or boiled off the face of the mold. The sand in the core may be damp or hard or not sufficiently dented. Pour one of the molds without a cope and watch the action of the metal as it rises. If it bubbles it is apparent that the mold is not satisfactory and you can take the necessary steps to remedy the trouble. Many founders dispense with a cope on all ring castings. They watch the metal as it rises and if slush starts to form on the top they touch it with a small rod to prevent it from sticking to the sides of the mold. In that manner all the dirt floats to the top and enters that part of the ring that afterward is cut off in the machine.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to the Editor, The Foundry, Penton Building, Cleveland.

Q & A

Rust Causes Trouble

QUESTION

Under separate cover we are forwarding a small iron casting containing a ¼-inch steel stud. Insertion of this stud causes nearly all the castings to blow and even in those that do not blow the studs are loose. How can we secure a solid casting in which the stud is gripped firmly?

ANSWER

The studs are rusty when you place them in the molds. Without going into the chemical reaction it is sufficient for all practical purpose to know that molten iron coming into contact with rust will cause nearly as bad an explosion as where it comes into contact with water. Local conditions, number to be handled, etc., will suggest the best method for removing the rust. Thus for a small number you might run a die down over the threads. Larger numbers may be pickled, or heated to a good bright red, then cooled and sand-blasted. Various coatings may be applied to preserve a clean surface until the stud has been enveloped in molten iron. Where the studs are prepared in small quantities and used each day, a light coating of oil, red lead, tar, or even a light layer of chalk is sufficient. Where larger quantities are prepared in advance, the clean stud is dipped in water glass or a tin bath. Either of these materials will prevent the molten iron from blowing and also will insure a tight grip on the stud. A possibility exists that you are using hot sand to form the molds. If that is the case, part of your trouble is due to steam condensing on the cold studs.

Q & A

Plate Warps in Center

QUESTION

We are making a core plate 14 x 30 inches, ¼-inch thick with the usual longitudinal, transverse and diagonal set of ribs on one face and pierced with rows of vent holes. We pour these castings with the best grade of iron, mold them in iron flasks, gate them in the center on the flat side and leave them in the molds all night. The pattern is straight and the molds are straight, but the castings are crooked. The face of the plate is convex, or according to the foundry term, it is humped up in the center. We shall appreciate your advice on how to prevent the casting from bending.

ANSWER

The core plate warps because the ribs in the center of the lower side are the last to cool. They contract and pull the ends of the plate down. In this particular case the trouble is intensified by pouring the casting in the center. The amount of warpage will determine the extent of the remedial measures required. If the plates are only bent a little, a change in the gating may be sufficient to effect a cure. Place a gate at each end and run the casting with two ladles. This will help to equalize the temperature of the metal and insure uniform contraction. Where the plates are heavily

bent it may be necessary to turn the complete mold over immediately after the casting is poured. By leaving the ends covered with sand and stripping the center down to the ribs, the contraction may take place uniformly. If the drag is extremely shallow it may be necessary to butt the sand over the ends while stripping it away in the center.

Q & A

Leaks Due to Core Gas

QUESTION

Under separate cover I am sending a small cast iron valve casting for your inspection. I am pouring these four to a gate and approximately 50 per cent of the castings leak at the same point. I have tried different methods of gating but results are the same.

ANSWER

The problem presented in this inquiry is rather mysterious. The defect is of such a character that a personal examination of all the factors and materials involved really is necessary before venturing a positive opinion. However, from the evidence submitted we are inclined to the opinion that your trouble is due to the two cores. The round boss or valve seat in the center causes the metal to flutter in the narrow wall between the two cores and this fluttering in turn results in a porous area that leaks under pressure. The obvious remedy is to use a core that vents more freely than those used at present.

GRAY IRON

Mixture for Grate Bars

QUESTION

We are contemplating the use of the following mixture for making up a quantity of 6 x 42-inch herringbone grate bars: Pig iron, 40 per cent; steel scrap such as structural and boiler plate, 20 per cent, and automobile cylinder blocks and pistons, 40 per cent. The average analysis of our pig iron shows 2.67 per cent silicon; 0.029 per cent sulphur 0.70 per cent phosphorus, and 0.64 per cent manganese. Will this be a good mixture for making high class grate bars? Do you know of a better one that has been tried out in practice?

ANSWER

The best type of grate bar probably would be one that had an all white structure, provided that the inherent brittleness of this iron could be removed. Since this cannot be overcome, the next best type of iron will be one that is on the border line between white fracture cast iron and gray cast iron. Therefore, we suggest that you increase your steel addition to 35 per cent and decrease your pig iron to 25 per cent. This should give an analysis in the final casting of about 1.25 per cent silicon; not over 0.100 per cent sulphur; 0.37 per cent phosphorus, and 0.50 per cent manganese. Better results may be obtained if the phosphorus could be reduced to under 0.20 per cent, and the manganese increased to 0.70 per cent.

Some makers of grate bars claim that they are getting a better product by the use of nickel and chromium. In this case about 1 per cent nickel and 0.50 per cent chromium is advocated. These alloys may be added in the form of ferrochromium and metallic nickel, a nickel-chromium bearing pig iron, or as an alloy of nickel and chromium. The silicon in the iron should be reduced to about 1.10 per cent.

Q & A

Wrinkles Due to Chill

QUESTION

We are making a gray iron casting 9 x 24 inches, ¼-inch thick on the edges and ¾-inch thick in the center. The face of this casting has to be chilled and although we have tried all kinds of coatings on the chills and have poured the casting level, on an incline and on edge the result is the same, an extremely uneven surface. The gray iron chill is 2 inches thick and 1-inch larger all around than the casting. We have tried the chills hot and cold. For a wash we have tried rosin, soapstone, and alcohol, plumbago and machine oil, kerosene oil and shellac. We pour our metal at 2690 degrees Fahr. and the analysis is: Silicon 1.74 per cent, sulphur 0.093 per cent, phosphorus 0.44 per cent, manganese 0.53 per cent. With this metal we secure a chill of approximately 3/32-inch on the face of the casting. For some reason the metal seems to be violently agitated in the mold and the result is a casting which cannot be ground without reducing it below the desired thickness.

ANSWER

The ridges in the casting are due to the fact that the metal solidifies instantly when it comes into contact with the chill. The iron immediately following has to climb over a ridge only to form another ridge and so on until the surface is covered. The remedy of course is to pour the metal fast and hot to cover the plate practically instantaneously. The most logical method for you to pursue in the present instance is to place the chill in the cope and allow the iron to rise up against it. In that manner you will eliminate the danger incident to metal flowing slowly in a thin stream. If, for any reason this plan is not feasible and you are forced to place the chill on the drag side, you can secure satisfactory results by arranging a multiplicity of gates through which the metal can be forced rapidly. Place a row of ⅝-inch pop gates 3 or 4 inches apart along the center of the plate. Build a basin on top of the cope to embrace the entire row of gates and pour the metal from two ladles, one at each end. Figure the amount of iron needed to fill the mold. Take that amount in the ladles and then dump the entire amount into the basin. The chill must be perfectly dry and preferably warm. Any of the coatings you have mentioned will serve to prevent the accumulation of moisture on the face of the chill. However, they must be used with discrimination. An overdose of coating material will develop a quantity of gas which has to escape upward since manifestly it cannot pass through the chill. Passage of this gas tends to agitate the metal and helps in the formation of ridges. The ideal coating is thin molasses water and plumbago dried on the face of the plate, preferably in the oven. Shellac is satisfactory if applied thin. So is kerosene oil and plumbago rubbed over the face with a brush or a handful of waste. However, the coating is only of secondary importance. The main features are a dry chill, hot iron and fast pouring.

Q & A

Makes Ingot Molds

QUESTION

We operate a foundry in Spain and are making ingot molds. Our molds have a short life and we would like to know what would be a good composition for this class of work. Will annealing help and at what temperature? We also make this type of mold in cast steel but the inside surface is not smooth. What kind of sand should we use for the core to avoid this difficulty?

ANSWER

In this country ingot molds usually are made from what is known as bessemer pig iron. This iron is low in phosphorus and silicon, and we believe that this type of pig iron is referred to on the Continent as hematite pig iron. The metal from the cupola should analyze as follows: Silicon, 1.75 to 2.00 per cent; sulphur, 0.08 per cent; phosphorus, 0.15 to 0.18 per cent, and manganese, 0.80 to 1.20 per cent. The iron should be poured as cold as is possible and still obtain solid castings. This will give a nice, smooth interior surface if the core is well-blacked.

Steel ingot molds have been tried in this country, but as far as we are aware, without success. They fail for several reasons. One of them is that the interiors as you mention, cannot be obtained as smooth as cast iron molds. Difficulty also in encountered in stripping the mold from the ingot. The steel ingot molds cut much easier

than the iron molds, and also they have a tendency to warp.

Cores for steel castings should be made from the highest grade of silica sand. Otherwise it will not have the necessary refractory properties. A wash of silica flour will assist in giving a smoother surface.

Q & A

Drum Is Too Small

QUESTION

Will you please give us a mixture or method of making gun iron or a mixture that will withstand heat? The casting we desire to make is used on the brake drum surface of a well drilling machine which has a high speed of 5000 to 6000 revolutions per minute. At this speed cast steel gets cherry red and cracks.

ANSWER

Gun iron is a cast iron made in the air furnace, and in days past was used for making cast iron cannon. At present this method of melting is used mainly in foundries making rolls. In the air furnace carbon may be reduced, sulphur pickup is low and generally the silicon is much lower than that melted in the cupola. Heat resisting irons generally are on the mottled or white side, and therefore are difficult to machine. One suggested mixture for this type of casting contains about 1.10 per cent silicon; 0.95 per cent nickel, and 0.50 per cent chromium, and is made with 80 per cent steel scrap in the cupola.

However, we believe that something must be radically wrong in the design of the brake drum referred to if it becomes cherry red. Usually the brake surface is designed so that it will be able to dissipate most of the heat generated during the braking action, and so that wear will not be excessive. If the steel surface becomes red hot, it is not advisable to substitute cast iron. If you wish to use cast iron, it will be best to secure the services of a designing engineer familiar with the type of brake.

Q & A

Wants To Close Grain

QUESTION

We are making ring blanks 4 to 10 inches in diameter, 12 inches long, and about ¾-inch thick. Our customers desire a close grain iron that will carry a high polish and still cut freely. We are using 2.75 to 3.25 per cent silicon pig iron and working in about 50 per cent good grade machine scrap. This iron cuts all right, but the grain is too open. How can we close the grain without reducing machinability?

ANSWER

From our calculations your finished castings probably will contain from 2.10 to 2.35 per cent silicon which is a little high, and undoubtedly is the cause of your iron being open in grain. This condition may be corrected by reducing the silicon through an increase in machinery scrap or by the addition of steel scrap to the extent of 10 or 15 per cent. If your machinery scrap also runs high in silicon, an increase in this item will not help much although it will to a certain extent close the grain. Use of pig iron lower in silicon will give a denser iron. Probably, the best thing for you to try would be the addition of steel scrap. We believe that the amount mentioned will close the grain without adding any difficulty in machining. However, there is a chance for dispute in that there does not seem to be any definite standard as to what really constitutes easy machining. One firm machining a good grade of iron will say that an open iron cuts like cheese, while a firm only used to the latter type of iron will complain that the good grade is quite hard to machine. Therefore, we suggest that you begin at 5 per cent steel. Watch your grain and get reports on machining. Keep increasing the steel until you achieve the desired results. One caution—be sure that your iron is hot and mixed well before pouring into the molds.

Q & A

Mixes Iron for Pistons

QUESTION

We are casting piston ring pots from 2¾ to 12 inches in diameter and 8 inches long. The smaller diameter pots average about ⅜-inch thick and the larger ones range from ½ to ¾-inch thick. We are sending you a double ring and a single ring that are used in a diesel airplane engine. The engines get pretty hot and the manufacturers say that they want a ring with a brinell hardness of 200 that will hug the wall in operation. The rings sent you have a tendency to close in when heated. Could steel scrap be used in the mixture?

ANSWER

We believe that a piston ring with a brinell hardness of 200 will be too hard, and will have a tendency to score the cylinder wall. Also we believe that difficulty will be encountered in machining a ring of this hardness especially where speed of machining and the finish obtained by machining are the biggest expense connected with ring making. Due to this feature and to requirements of tension, etc., specified by engine makers, many foundries making ring castings use nothing but pig iron and their own return scrap. Unless you have had considerable experience in making steel scrap additions, and are sure that the iron poured is well mixed, we do not advise its use. Visual examination of the fracture of the double ring sent us indicates that it is soft, the fracture being coarse and black. The heavier single ring shows a better structure in that it is finer, and gray in color.

Our opinion is that the mixture used in the heavier ring should be employed in the lighter ones, provided that it can be machined satisfactorily. Analyses of piston rings range from 2.00 to 2.85 per cent silicon; sulphur as low as possible; phosphorus, about 0.50 per cent, and manganese around 0.70 per cent. The lower silicon is used in the large and heavy rings say over 5 inches in diameter. Since you do not state what mixture or analysis you are running at present, nor the size of your cupola, we can only suggest that you try a mixture containing 50 per cent pig iron and 50 per cent your own return scrap. The pig iron should contain about 3.00 per cent silicon; not over 0.05 per cent sulphur; not over 0.50 per cent phosphorus, and about 1 per cent manganese.

MALLEABLE

Builds Small Furnace

QUESTION

Have you any information on how much it would cost to build a 4-ton air furnace for melting iron for malleable work? Are there any books containing information on the design? What firms supply air furnace equipment?

ANSWER

As far as we are aware there is no book that deals specifically with the design of air furnaces. Some information is given in Schwartz's *American Malleable Cast Iron*, and a good general discussion of fuel-fired furnaces is contained in, *Flow of Gases in Furnace*, by Groume-Grjimailo. It is only fair to say that units of such small size are not likely to be at all economical and it probably would be better to buy the castings. Some small units that appear to hold promise of being economical in fuel and labor are two rotary type furnaces developed in Germany. However, both furnaces are expensive.

The cost of building furnaces varies widely with the type of labor method employed. A rough estimate for a 4-ton furnace would be $2500 exclusive of the stack which would add about $1500 more. These are only guesses and may differ considerably from those of engineers working from actual plans and computing costs. If powdered fuel is to be used, the cost will run much higher for the additional equipment of burners and coal dryers and pulverizers.

Numerous firms advertising in THE FOUNDRY will design, build and supply necessary equipment for an air furnace.

Problems in Nonferrous Founding

By Charles Vickers

Must Use Good Alloy

We would like to obtain a formula and direction for melting an alloy suitable for making matchplates. If possible it should have no contraction, and still be light and cheap. We also understand that there are foundries in the United States that cast ornamental ware in molds made of asbestos and plaster of paris. What is the purpose of that method of casting and its advantages?

A light alloy that is used considerably for making matchplates contains 87 per cent aluminum; 8 per cent copper; 3 per cent silicon, and 2 per cent tin. There are no alloys known that do not contract which are suitable for matchplates. Also, there is no cheap alloy for the purpose. The best is none too good, as the alloy itself is a small item compared to the work involved in making matchplates. To make the alloy mentioned, it is necessary to have two hardeners. One is an alloy containing 50 per cent aluminum and 50 per cent copper, and the other is an alloy of silicon and aluminum in the proportions of 50-50 or 25-75.

The alloy is made by melting 16 per cent of the copper-aluminum alloy, the proper proportion of the silicon-aluminum alloy to give 3 per cent silicon including the known, original silicon content of the commercial aluminum ingot used, and aluminum ingot to make up the remainder. The tin is added last and sometimes is omitted. Manganese should be eliminated as it causes sluggishness of the molten metal and a tendency to *lather*.

Plaster of paris molds containing a small amount of abestos, and brick dust, or other refractory materials are used in the jewelry trade for casting silver ornaments of which only a limited number are required. Coal ashes and slag wool have been used successfully to replace the asbestos. Since in the case of high melting point alloys, the molds can be used only once, the process is expensive. The materials are costly and the drying of the molds takes considerable time. At one time the method was introduced into the brass foundry for making highly finished castings of an aluminized, high-zinc alloy. Such castings usually are too costly for general use because their perfection of detail does not eliminate machining operations entirely.

Q & A

Metal Must Not Oxidize

We have on hand a large amount of brass and bronze borings and turnings which we would like to use up in making castings. We have in mind pouring the metal into molds for heavy castings, such as will require No. 300 crucible to pour. We use the old type coke-fired furnaces, and would like to know the best practice in melting these borings.

As the borings simply are rather finely divided metal, and oxidize easily, the important thing to keep in view when melting is to shield such metal to the greatest extent possible from the furnace atmosphere and gases, which are responsible for the deterioration of the metal.

So the best practice evidently will consist of melting the borings so quickly they have no time to oxidize. This is not merely a question of rapid melting, for that may only result in sintering the mass of borings into a salamander. Instead of starting the pot off by putting in a lot of loose borings, it is best to start with an ingot or two. When these are melted, under the protection of charcoal in the case of a coke-fired, pit-type furnace, a bath or *heel* of molten metal is obtained in the crucible that can be brought to a high heat, say 2500 degrees Fahr., or more. At this temperature we can dissolve a considerable amount of the turnings in the heel. They will melt quickly and when the bath of metal gets cooled it is reheated. By repeating this process the pot is finally filled with metal which can be poured into ingots or castings.

There has been little chance for oxidation as the cooled metal when being reheated is covered with charcoal. Also a little common salt is added. When the pot is filled, the addition of around three ounces of phosphor copper per 100 pounds of borings or turnings should remove the little amount of oxidation products that have been produced. Before pouring heavy castings, however, with metal on the first melt, we suggest that a trial heat or two be run off, and poured into small work which is subjected to careful scrutiny to determine just how successful the operation has been carried out in avoiding injurious oxidation, and aeration. If the castings are dense and free of all gas holes, then there is no reason why such metal in future heats should not be poured direct into castings.

Q & A

Cores May Not Be Cause

We make pressure castings of aluminum bronze, silicon bronze, and lead, and we believe that our cores can be improved. Those for lead we desire to crush easily and be removed from the casting without too much labor or lengthy soaking. The cores are made from lake sand mixed with molding sand, with flour as a binder. The castings are cast in sand from the same heap of No. 1 Albany sand.

The unsoundness of the castings may be due to causes lying outside of the cores. Aluminum bronze in particular is a difficult alloy from which to make pressure castings and the proper location of gates and risers is important. Otherwise the castings will be drossy and leak under slight pressures. The best type of core to use with aluminum and silicon bronze is an open sand core bonded with dextrine rather than oil. The metal should be degasified before pouring.

A dextrine bonded core also is preferable for lead. The metal holds the core strongly when cast as the metal is not hot enough to burn out the bonding materials. If lead is poured too hot, it will eat into the core. Cores for lead castings should be protected by several coats of plumbago so that all interstices of the sand are filled and the metal cannot enter. Polishing the final plumbago coating with the hand will assist in filling the voids in the sand surface.

Standard Trade Customs
Adopted by Steel Founders' Society

Articles Include Only Those Practices Recognized as Standard and in Common Use by Most Steel Foundries

FOR some time considerable confusion has existed in the minds of both the buyer and seller of steel castings on certain specific questions such as: Is the steel foundry responsible for transportation charges on pattern equipment to and from the foundry? Is it customary for steel foundries to store inactive pattern equipment indefinitely without charging the customer? Is it the duty of the customer to see that proper methods are employed by the foundry to insure the production of satisfactory castings?

These and other questions which are answered by the general usages and policy of the steel foundry industry which have come down through the years, are clarified by the code of standard trade customs which recently have been completed under the auspices of the Steel Founders' Society of America.

Only those practices which have come to be recognized generally as standard and in common use by most steel foundries have been included. No arbitrary conditions or rules have been set up prejudicial to either the buyer or seller of steel castings. The new code clearly sets forth the regulations and conditions under which steel castings are bought and sold.

There is nothing in the code which in any way regulates or standardizes prices or leads to price maintenance. It has been created solely for the purpose of securing uniform usage and definitely recording conditions of sales which will guide the buyers of steel castings and those producers who may not be acquainted with prevailing methods of conducting the business.

The standard sales contract which has been developed by the Steel Founders' Society meets a long-felt need of the steel foundry industry. On the reverse side of the contract form are printed the standard trade customs of the industry, which are made a part of the sales agreement.

In cases where the standard sales contract does not fit the conditions, a standard order acceptance form, which fulfills much the same purpose, has been provided for use in the industry.

The purpose of these trade customs is to clarify and define conditions generally accepted with respect to the purchase and sale of steel castings. Their careful observance by the buyer and seller will benefit both.

These regulations, recognized as standard in the steel foundry industry, should be made a part of all purchases and sales of steel castings, thus avoiding misunderstandings which in the final analysis always are unsatisfactory and frequently represent a loss, either to the customer or the foundry, that could have been prevented.

The standard sales contract and order acceptance form and quotation sheet are for the purpose of simplifying the transaction of business between the steel foundry and its customers. Their use helps to prevent losses, avoid possible litigation, and because of their fairness to buyer and seller, reduce disputes and delays to a minimum.

Standard conditions of sale, standard sales contracts and acceptance forms have been found to speed up commercial transactions, saving time and money and avoiding the misconstruing of terms, uncertainties, disputes and delays.

It is important that the *purchaser* as well as the seller of steel castings insist upon their use and observance.

Standard Trade Customs:

A—All quotations are made and all steel castings are sold upon the following terms and conditions:

Quotations:

B—All requests for quotations shall give actual or estimated rough weights of the castings, but estimated weights shall not be used as a basis for billing.

C—All quotations on steel castings shall be exclusive of pattern equipment. The latter, if made by the foundry or requiring alterations, shall be an extra or separate charge to the purchaser.

D—Unless otherwise specified, castings are sold as unmachined castings. Terms—Net cash, 30 days from date of invoice. F.O.B. Foundry.

E—When the quotations involve the making of piece prices, approximate weights shall be agreed upon and quotations shall be subject to revision on any variation from the original design.

F—Unless specified, any quotations containing more than one class of work, at an average price per pound, is furnished with the understanding that acceptance is for the entire lot, and quotations are good for thirty (30) days only and arrangements for pattern equipment shall be provided for within that time.

Pattern Equipment—General:

G—To eliminate errors patterns should be painted in accordance with

Imprint of Foundry's name and address

SALES CONTRACT

..... Place and Date

..... (Name of Foundry) sells and will deliver to

..... (Name of Buyer) and

..... (Name of Buyer) buys and will receive the product hereinafter described at the prices and on the terms and conditions hereinafter set forth.

DESCRIPTION, SPECIFICATIONS, AND WEIGHTS.
PRICE
TERMS
DELIVERIES
F. O. B.

CONDITIONS — Each shipment is to be a separate and independent sale for purposes of payment and settlement of claims. Fault in weight or quality shall not affect this contract with respect to other deliveries.

SPECIAL — This contract made subject to the further conditions printed on the reverse of this sheet which are hereby included and made a part hereof. Subject to acceptance at home office of seller.

ACCEPTED

..... (Buyer)
By

Date .....
(Fill out in duplicate)

..... (Seller)
By

..... (Buyer)

the following standard practice:

Surfaces to be left *unfinished* are to be painted *black.*

Surfaces to be *machined* are to be painted *red.*

Seats of and for loose pieces are to be *red stripes on a yellow background.*

Core prints and seats for loose core prints are to be painted *yellow.*

Stop-offs are to be indicated by *diagonal black stripes on a yellow base.*

H—Patterns, coreboxes and loose pieces thereof shall be marked properly for identification.

I—All transportation charges on pattern equipment to and from the foundry shall be paid by the purchaser.

J—All packing and crating cost for transportation of patterns to and from the foundry shall be paid by the purchaser.

Responsibility for Pattern Equipment:

K—Insurance against fire and the elements is the responsibility of the purchaser.

L—The foundry shall be responsible for loss or damage to pattern equipment only when due to careless handling or negligence on the part of the foundry, but not on account of fire or other causes beyond its control.

M—The foundry shall not provide storage space for patterns for which no orders have been received during a period of two years and notification shall be sent to customer for advice as to whether pattern shall be returned or destroyed.

Pattern Equipment Charges:

N—Subject to purchaser's approval, pattern changes or repairs which become necessary on account of ordinary wear shall be made at the purchaser's expense.

O—When the purchaser furnishes skeleton patterns, coreboxes, sweeps or conjunction patterns which increase the cost of production of castings, an extra charge will be made.

Changes, Alterations and Cancellations of Orders:

P—Changes in orders shall be confirmed in writing by the purchaser.

Q—Cancellations of orders must be agreed to mutually by the foundry and the purchaser.

Liability, Claims of Error and Replacements:

R—All agreements are contingent upon fires, strikes, accidents or other causes beyond the foundry's control.

S—To be allowable, claims or error in weight or number of castings shall be made by the purchaser within ten (10) days after receipt of the castings.

T—The foundry shall not be responsible for machine work, labor charges or other expenses incurred on castings which are later rejected as defective.

U—Foundry is responsible only to the extent of replacing castings rejected due to defects in workmanship and material, and such castings must be reported or returned to the maker within a reasonable time.

Name of company and address

ACCEPTANCE OF ORDER

TO.....

.....

.....

We have received your order, ... dated ....., which we accept in accordance with the Standard Trade Customs of the Steel Foundry Industry, which are printed on the back hereof, and which are a part of this acceptance.

Very truly yours,

.....

BY:.....

Should occasion arise to write regarding this order, kindly refer to our No. .....

Consequential, Special or Contingent Damages:

V—The foundry shall not be liable for consequential, special or contingent damages.

Specifications:

W—When chemical specifications, except phosphorus and sulphur, are imposed by the purchaser, the foundry shall not be held on physical tests and vice versa, except by agreement.

Arbitration:

X—Any controversy or claim arising out of or relating to a contract or the breach thereof shall be settled by arbitration, in accordance with the rules, then obtaining, of the American Arbitration association, and judgment upon the award rendered may be entered in the highest court of the forum, state or federal, having jurisdiction.

Cooperation:

Y—The foundry or producer will, whenever possible, arrange for the inspection of his plant equipment and product in order to acquaint the purchaser with the foundry problems and to assure him of the desire and advisability of close co-operation between them to the end that a quality product and best service may be furnished.

British Iron and Steel Institute Meets

Among the outstanding events at the annual meeting of the British Iron and Steel institute, held May 1 and 2, was the presentation of the Bessemer medal to Eugene Schneider, steelmaster, Creusot Works, France and Dr. Walter Rosenhain, director, National Physical Laboratory, Teddington, Eng. Among the papers that created much discussion was "Tin and Sheet Mill Rolls, Their Treatment, Performance and Premature Failure in Service," by E. R. Mort, Griffithstown, Monmouthshire, Eng. One speaker in discussing the paper said that he had found the optimium silicon content between 1.00 to 1.25 per cent, and that while the desirable depth of chill was ¾ inch the safe limit can go up to ⅞ inch. According to Mr. Mort, the surface hardness of rolls ranges from 52 to 56. One speaker said that he never had obtained less than 56, except with rolls containing low carbon, and that in several cases he had obtained 50. Slow cooling of the rolls in the mold gave slightly better results than if the rolls are cast one day and shaken out the next.

In discussing polishing, it was pointed out that higher carbon rolls polish better. Some method of measuring the chill depth must be found, according to the opinion of the majority. Various methods of heating rolls were discussed and John Shaw commented upon his experiences along that line. Other papers presented at the meeting include "Alloys of Iron Research—Part IX—The Constitution of the Alloys of Iron with Silicon," by J. L. Haughton and M. L. Becker; "The Effect of Melting Conditions on the Microstructure and Mechanical Strength of Gray Cast Irons Containing Various Amounts of Carbon and Silicon," by A. L. Norbury and E. Morgan; and "The Properties of Some Steels Containing Chromium," by A. R. Page and J. H. Partridge.

Refractories Institute Elects Officers

American Refractories institute held its annual meeting May 19 at White Sulphur Springs, W. Va. The following officers were elected at that meeting. President, W. J. Westphalen, vice president, Laclede-Christy Clay Products Co., St. Louis; vice presidents, W. B. Coullie, general sales manager, Harbison-Walker Refractories Co., Pittsburgh and P. S. Kier, vice president, Kier Fire Brick Co., Pittsburgh; treasurer, C. C. Edmunds, vice president, McLain Fire Brick Co., Pittsburgh; and secretary, Dorothy Texter, 2218 Oliver building, Pittsburgh.

The following directors also were elected: J. M. McKinley, vice president, North American Refractories Co., Cleveland; W. B. Coulie; C. C. Edmunds; Roger A. Hitchins, secretary, General Refractories Co., Philadelphia; W. H. Peterson vice president, M. D. Valentine & Bro. Co., Woodbridge, N. J.; Charles S. Reed, Chicago Retort & Fire Brick Co., Chicago; R. M. Sievers, district sales manager, Harbison-Walker Refractories Co., St. Louis; and W. J. Westphalen.

The FOUNDRY Family Photograph Album

Upper Left

E. F. STOCKWELL

Barbour - Stockwell Co., Cambridge, Mass.

Upper Right

J. W. POHLMAN

J. W. Pohlman Foundry Co., Buffalo

Lower Left

SCOTT MACKAY

University of Wisconsin, Madison, Wis.

Lower Right

H. E. PRIDMORE

International Molding Machine Co., Chicago

CONVERSION TABLES FOR AMERICAN MEASURES

Measures of Length

Millimeters = Inches ÷ 0.03937
Millimeters = Inches × 25.4
Centimeters = Inches ÷ 0.3937
Centimeters = Inches × 2.54
Meters = Inches ÷ 39.37
Meters = Feet ÷ 3.281
Meters = Yards ÷ 1.094
Kilometers = Miles ÷ 0.6214
Kilometers = Feet ÷ 3280.8
Kilometers = Miles × 1.6093

Measures of Volume

Cubic Centimeters = Cubic Inches × 16.387
Cubic Centimeters = Fluid Drams (U.S.P.) × 3.697
Cubic Centimeters = Fluid Ounces (U.S.P.) × 29.57
Cubic Meters = Cubic Feet ÷ 35.315
Cubic Meters = Cubic Yards ÷ 1.308
Cubic Meters = U. S. Gallons (231 cubic inches) ÷ 264.2
Liters = Cubic Inches ÷ 61.022
Liters = Fluid Ounces (U.S.P.) ÷ 33.81
Liters = U. S. Gallons (231 cubic inches) ÷ 2642
Liters = U. S. Gallons (231 cubic inches) × 3.785
Liters = Cubic Feet × 28.316
Hectoliters = Cubic Feet ÷ 3.531
Hectoliters = Bushels (2150.42 cubic inches) ÷ 2.838
Hectoliters = Cubic Yards ÷ 0.1308
Hectoliters = U. S. Gallons (231 cubic inches) ÷ 26.42

Measures of Weight

Grams = Grains ÷ 15.432
Grams = Dynes ÷ 980.7
Grams (water) = Fluid Ounces × 29.57
Grams = Ounces (Avoirdupois) × 28.35
Grams per Cubic Centimeter = Pounds per Cubic Inch × 27.68
Joule = Foot Pounds ÷ 0.7375
Kilograms = Pounds ÷ 2.2046
Kilograms = Ounces (Avoirdupois) ÷ 35.274
Kilograms = Tons (2000 pounds) × 907.19
Kilograms per Square Centimeter = Pounds per Square Inch ÷ 14.233

(*Concluded on Data Sheet No.* 818)

CONVERSION TABLES FOR AMERICAN MEASURES

(*Concluded from Data Sheet No.* 817)

Kilogram-meters = Foot Pounds ÷ 7.233
Kilograms per Meter = Pounds per Foot ÷ 0.6720
Kilograms per Cubic Meter = Pounds per Cubic Foot ÷ 0.06243

Measures of Area

Square Millimeters = Square Inches ÷ 0.001550
Square Millimeters = Square Inches × 645.2
Square Centimeters = Square Inches ÷ 0.155
Square Centimeters = Square Inches × 6.452
Square Meters = Square Feet ÷ 10.764
Square Kilometers = Acres ÷ 247.1
Hectare = Acres ÷ 2.471

Miscellaneous

Kilowatts = Horsepower ÷ 1.340
Watts = Foot Pounds per Second ÷ 0.7375
Calorie = B.t.u. ÷ 3.068
Calorie (large) = B.t.u. ÷ 3.971
Cheval Vapeur = Horsepower ÷ 0.9863

Stress Values—American, Metric and English

Pounds per Square Inch	Kilograms per Square Millimeter	English Tons per Square Inch
250	0.175	0.112
500	0.350	0.222
1,000	0.700	0.446
2,000	1.400	0.893
3,000	2.101	1.339
4,000	2.801	1.786
5,000	3.515	2.232
10,000	7.031	4.464
15,000	10.546	6.696
20,000	14.062	8.929
25,000	17.577	11.161
30,000	21.092	13.393
35,000	24.608	15.625
40,000	28.123	17.857
45,000	31.639	20.089
50,000	35.154	22.321
55,000	38.670	24.554
60,000	42.185	26.786
65,000	45.700	29,018
70,000	49.216	31.250
75,000	52.731	33.482
80,000	56.247	35.594
85,000	59.762	37.946
90,000	63.277	40.179
95,000	66.793	42.411
100,000	70.308	44.643

THE FOUNDRY DATA SHEET, JUNE 15, 1930
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Control of Materials Features Die Casting Plant

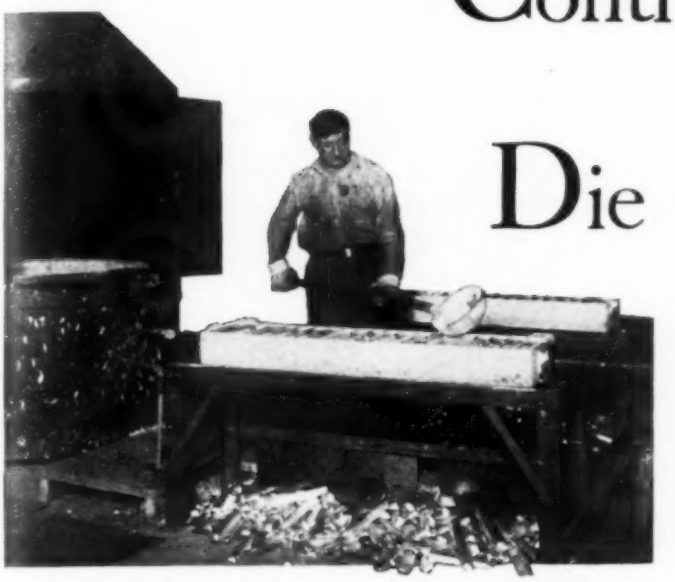


Fig. 1—Ingots are made on water-cooled molds which are tipped to dump the metal

Backtracking Is Eliminated as the Product Moves from the Casting Department to the Shipping Room

BY

HERBERT R. SIMONDS

MODERN development of die casting as an established industry is well illustrated by the operations of the Allied Die Casting Corp. in its new plant in Long Island City, N. Y. This plant, completed late last fall, is just getting into full production. The company formerly occupied a smaller building nearby which had been equipped as demand necessitated without any coordinated plan. But the many lessons learned in its operation were invaluable aids to the designers of the present efficient and well coordinated manufacturing unit.

The production of die castings is a highly specialized art built around the ingenious and complicated mechanism known as a die-casting machine, and depends in large measure for its success on the resourcefulness and skill of the designers of its dies.

The diemaking department of the new plant occupies as much space as the casting department. The building is four stories high and is built of reinforced concrete construction with large windows on all four sides. It has 75,000 square feet of floor space, and the layout of machines and equipment is such as to give a sense of roominess and freedom from crowding even though the design is based on high production.

The casting department on the top floor is provided with skylights in addition to the large windows. The floor below houses the diemaking shop which maintains close contact with the casting department. Because of the handling of steel blocks and the temporary storage of dies and die parts in the die shop it has been equipped with a maple parquet flooring. Castings produced on the top floor travel down to the second floor to the trimming and finishing department and after being processed continued to the shipping department on the first floor. Here also is located the foundry where ingots or metal pigs are cast for the casting machines. These ingots are taken by freight elevator up to the casting department and the work in process flows constantly downward. The plant laboratory is located in a pent house on the roof.

New Plant Brings New System

Advantage of moving to a new plant was taken by the company to put into effect a new routing and production system. Under this system customers' orders on receipt go to the order department where after careful checking a plant work order is made out. A copy of such an order is shown in Fig. 7. It is the duty of the order department to see that each incoming order corresponds with the estimate or with an authorized quotation. If the order is from an old customer, the file is consulted to determine whether the dies are on hand and whether the previous order was produced at a profit. It often happens that a customer in the habit of ordering at a certain price in say 10,000 lots sends in an order for 5000 assuming that the price will be the same. Whenever a change in quantity is made, the new order must go to the plant manager for price approval or for the setting of a new price.

After the incoming order has been checked, a requisition for the shop order is made out and sent to the stenographic department where the actual order is made with six carbon copies. If dies are to be made a separate work order is issued for this, and to distinguish between the two the die orders are made on tan colored stock and the castings orders on white stock. One copy of the die order goes to the die shop where it serves as a notification of work in prospect and enables the foreman of the shop to order his materials. Another copy of the die order goes to the tool department and becomes the authority for the design and construction of trimming and punching tools as may be required.

Copies of the casting order go to all departments concerned and prepare the way for actual production. One copy, for instance, goes to the cost department where it becomes the record of the cost summary on that particular job. The total cost includes the cost of the metal, the overhead apportionment and the labor charge from the cleaning, casting, production and shipping departments.

The form which goes to the shipping department is a card containing the order on one side and a record of shipments on the back. Each day that a shipment is made against the order the date, the quantity shipped, and the balance still to be shipped under the order are entered. In order to keep records under each order from becoming too bulky large orders are frequently split up into four or more smaller ones. Thus if a consumer orders 50,000 of a

Deliveries	SHIPPING RECORD ALLIED DIE CASTING CORPORATION FACTORY ORDER CASTINGS SHIPPING DEPARTMENT	Order No. 3846 Date 19
	Customer	Customer's Order No.
	Address	Date
	Ship to Via	

Metal	Quantity	Description	Part No.	Die No.	B/P No.
Weight					

Specifications

FORM M 10-C 2M 8ET9 7-29-E/T

SHIPMENTS

Date	P.S No.	Quantity	Balance	Date	P.S No.	Quantity	Balance	Date	P.S No.	Quantity	Balance

Fig. 2—Copy of the factory order which goes to shipping department

certain casting the head of the order department may divide this into five factory orders of 10,000 each. A weekly time ticket is made out for each man in the plant. These tickets are of different color to indicate the different departments. For instance, the casting department has a blue ticket, the trimming department a white ticket, the tool department a yellow ticket and the die department a buff ticket.

Dies Are Expensive

Each man's time is distributed to the various factory order numbers, and these time records and the charge slip for material all go to the cost department for checking and entering. The system is not as simple as it sounds for there are adjustments to be made for bonuses and for piece work pay in certain departments. However, the importance of accurate costs in a die-casting plant is well appreciated and the cost department and estimating and production departments work in close co-ordination.

In a foundry patterns usually are considered stock in trade inasmuch as their possession helps greatly in bringing in additional work and the same is true even to a greater extent with dies in a die-casting plant. Few people outside of the die-casting industry itself realize the complexity and elaborate detail of the modern set of dies for the casting work. The cost of the average die used for producing die castings approximates or perhaps even exceeds the cost of an average automobile. A typical die is shown on Fig. 5. This is intended for use on a hydraulically-operated machine which automatically moves the cores into place for casting and then withdraws them afterwards for the removal of the piece. Practically all dies are water cooled and all are designed with some provision for the escape of air as the metal rushes in.

Dies usually are made of chrome-vanadium steel and are heat treated carefully before being placed in service. An important feature of the Allied Die Casting Co. plant is its modern heat-treating department. Before starting work on a die any strains, which may be present in the alloy steel block, are eliminated by normalizing. Later the die is heated above the critical temperature then quenched in oil and drawn.

The design of a typical die for die-casting work is similar to a green sand mold in that it is composed of two main parts, has gates for the inflow of metal and makes use of cores. But in many other respects it differs widely.

Nearly all dies are provided with ejector pins. These are slender steel rods withdrawn below the surface of the impression during casting but moved up through the surface and against the casting to dislodge it from the die after the die has been opened. These ejector pins are made of high-carbon steel carefully heat treated, and there often are 20 to 30 to a single die. In the withdrawn position they are flush with the surface of the die and their imprint on the castings scarcely is noticeable.

Ejector Pins Provided

The process of casting is fairly simple, but back of this simplicity is the elaborate service furnished each die-casting machine and the intricate design of the die as already suggested. Each die-casting machine must be equipped with gas for heating the bath of metal, with a high-pressure air line for shooting the metal into the die, a low-pressure air line for cleaning the die after each shot, running water intake and outlet for cooling the die and electricity for light. In addition, nearly all modern machines have the dies opened and closed hydraulically, which requires a high-pressure hydraulic system with a return pipe for the discharge. At the Allied Die Casting plant most of the machines have eight service pipes, four for water, two air, one each for gas and electricity.

The elaborate piping system used to serve the die-casting machine is carried on hangers from the ceiling of the floor below the casting floor where the pipes are always in easy

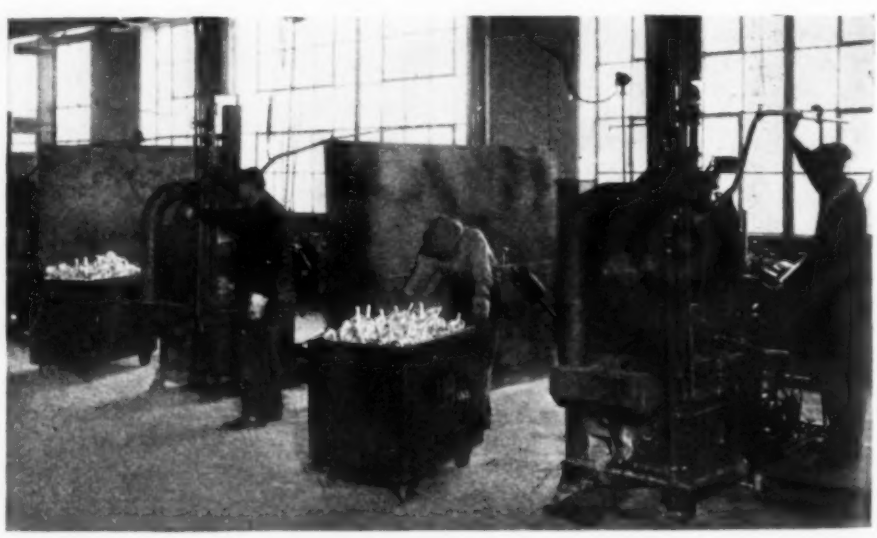


Fig. 3—Long rows of standardized die-casting machines extend down both sides of main casting floor

access for changes or repairs. Each complete system is painted a different color to facilitate tracing or locating a pipe at any point of the building for extension or alteration. In addition to the piping and the utilities mentioned, there is an exhaust system to remove the fumes and hot air from each machine and also a cold air blower system to provide fresh cool air for the machine operators.

To make die castings, a die is fitted to a casting machine, ingots are melted in the machine's reservoir, compressed air is turned on, hydraulic pressure is admitted to the operating cylinders, a lever is pressed which sends a shot of metal into the die and the first casting is cast; the die then is opened, the ejector pins are moved forward and the casting drops into a container or else is removed by hand. This process is repeated until an order is complete.

ALLIED DIE-CASTING CORP. WEEKLY TIME TICKET CASTING DEPT.

PD.	WK.	NAME								WEEK ENDING		CLOCK NO.	
DAY	DATE	ACT	ORDER	DIE	SHOTS	CLOCK CARD	TIME	REQUIRED PER HR.	REQUIRED TOTAL	EXCESS SHOTS	R	BONUS	%	AMT. EARNED
211	317													

TOTAL WEEKLY BONUS $

TOTAL WKLY. HOURS @ $ DAY RATE $

FORM H 2 1000-4-29 TOTAL PAYMENT $

Fig. 4—Weekly time tickets carry distribution of all labor to the different order numbers and these form the basis of an accurate cost system

Temperature Controlled

The die-casting machine used exclusively at the Allied Die Casting plant is one designed about seven years ago. It has been improved and developed since. The ingots are melted by gas in a large reservoir at one end of the machine and the temperature of the metal bath is maintained automatically by pyrometer control. The main frame of the machine carries the die with the elaborate mechanism for the placing and withdrawing of the various cores, for the closing and opening of the dies and for the ejection of the casting after it has been made. Within the reservoir is a small container known as a gooseneck which ordinarily is submerged in the molten metal but which is raised with a lever at the time of casting so as to bring fresh hot metal against the nozzle ready for shooting into the die. The machine uses 450 pounds of air pressure to force the metal into the die, and 800 pounds hydraulic pressure to operate the automatic features. The air for cleaning the die after each casting is supplied at 100 pounds pressure.

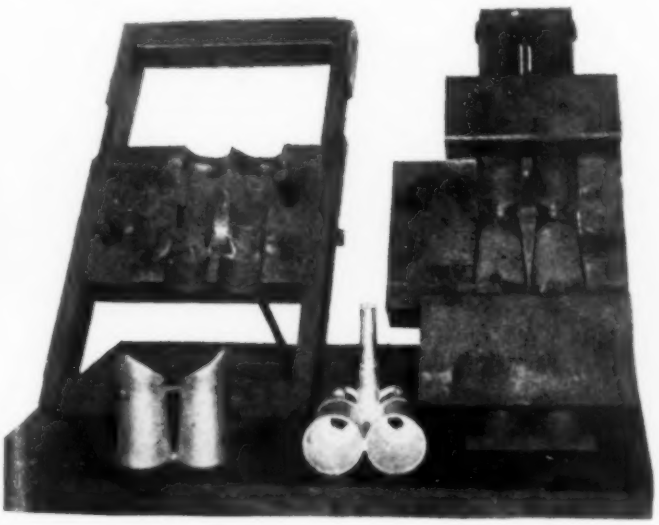
Many different kinds of metal alloys are used for die casting but the two chief groups are known as the aluminum alloy which requires about 1250 degrees Fahr. in the molten bath, and the zinc alloy calling for 800 to 850 degrees Fahr. Part of the science of die casting is the time element between filling a die and ejecting the cooled casting. The design of the space for the cooling water in the die itself has a direct bearing on the speed of cooling of the casting, and this feature emphasizes the need for close co-operation between the casting department and the die-designing department.

For small work hand-operated machines are used. In these, hand levers close and open the dies and eject the castings. The hydraulically-operated machines often produce 350 casts an hour. Dies are changed in from 10 to 15 minutes. One die will often stand up successfully during 250,000 casts.

Dies Have Long Life

The so-called cleaning department on the second floor is in reality a finishing and cleaning department. The castings leave the dies with small fins at the parting line. Die construction, which will leave slight fins, is desirable to allow for escape of air at the inrush of the metal. These fins are removed by trimming dies on small presses. The gates sometimes are cut off with power gate cutters or removed with band saws. One end of the cleaning floor is equipped with a variety of machine tools and is used for a certain amount of finishing work frequently specified. The chief work in this section is drilling, although light lathe and shaper work also is done.

In the foundry on the first floor are two oil-fired and three gas-fired



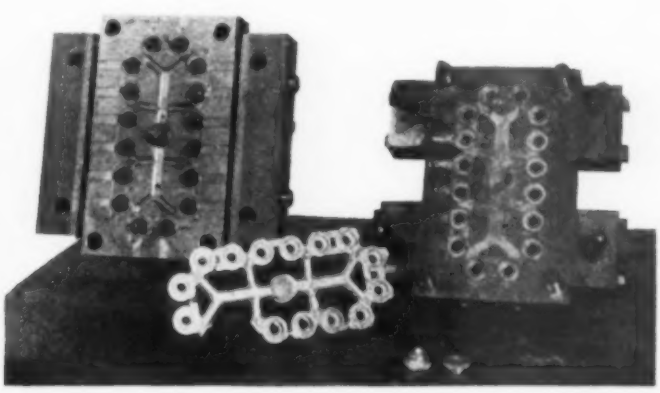


Fig. 5—(Left)—The shape of these eye-piece castings involves two sets of cores introduced from opposite sides. Fig. 6—(Above)—Aluminum bushings are made 16 to each impression

COST ASSEMBLY SHEET

ALLIED DIE CASTING CORPORATION

FACTORY ORDER CASTINGS

COST DEPARTMENT

Deliveries

Order No. 3846

Date 19

Customer

Customer's Order No.

Address

Date

Ship to Via

Metal	Quantity	Description	Part No.	Die No.	B/P No.
Weight					

Specifications

FINAL COST SUMMARY

Date Completed Quantity Finished

	Direct Cost	Casting Hours	Rate per Hour	Overhead	Cost with Overhead	Cost per M
Metal						
Cleaning						
Casting						
Total Mfg. Cost						
Overhead						
Total Cost						

CASTING DEPT.						CLEANING DEPT.						FINISHING DEPT.					
Date	Clock No.	Hours	Castings	Rate	Amount	Date	Clock No.	Hours	Castings	Rate	Amount	Date	Clock No.	Hours	Castings	Rate	Amount

Fig. 7—One copy of factory order for castings goes to cost department where it becomes the record of the complete cost summary of job

furnaces. Near each furnace is a water-cooled ingot mold. The metal from the furnace is taken out with ladles and the molds are filled as shown in Fig. 1. The entire mold plate then is tipped and the ingots slide down a steel apron upon the floor or into containers for transporting to the casting department where they are melted in gas-fired reservoirs mounted on the die-casting machines.

Walker Vehicle Co., Chicago, subsidiary of the Commonwealth Edison Co., has purchased the Barrett-Cravens, Chicago, and the Automatic Transportation Co. Inc., Buffalo.

Standard Casting Alloys

METAL alloys now used for die-casting work are fairly well standardized. The three most common are as follows:

	Element	Per Cent
Zinc Alloy No. 1	Zinc	93.0
	Copper	3.0
	Aluminum	4.0
	Magnesium	trace
Aluminum Alloy No. 1	Aluminum	91.0
	Copper	4.0
	Nickel	4.0
	Silicon	1.0
Aluminum Alloy No. 2	Aluminum	90.5
	Silicon	8.0
	Copper	1.5

The steel used for dies also has been standardized by many manufacturers. A typical steel alloy for aluminum work follows:

	Element	Per Cent
Steel Alloy No. 1	Carbon	0.45
	Silicon	1.10
	Manganese	0.30
	Tungsten	6.00
	Chromium	6.00
	Cobalt	0.75

One company has the following specifications covering die alloys for aluminum work:

	Element	Per Cent
Steel Alloy No. 2	Carbon	0.4
	Silicon	0.15 to 0.30
	Mang'se	0.65 to 0.85
	Chrom.	1.75 to 2.00
	Vanad.	0.20 to 0.30

A typical alloy for use on zinc work follows:

	Element	Per Cent
Steel Alloy No. 3	Carbon	0.50
	Silicon	0.45
	Manganese	0.75
	Chromium	1.00

Phosphorous and sulphur are kept low in all of the foregoing alloys, usually 0.025 per cent and under.

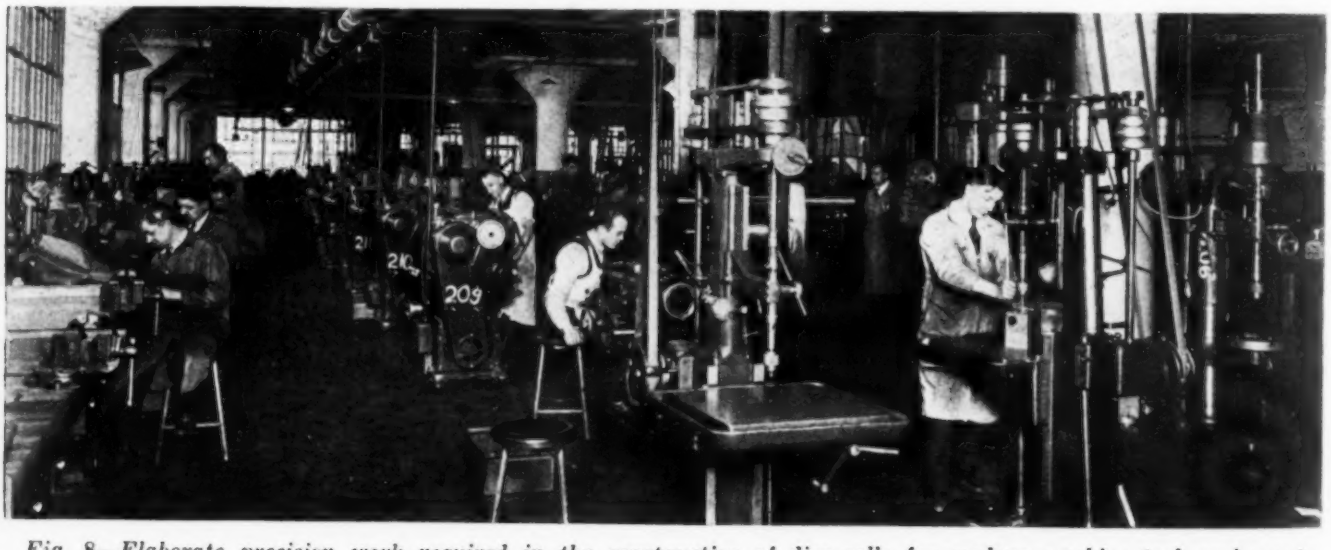


Fig. 8—Elaborate precision work required in the construction of dies calls for modern machine tool equipment

Four Major Divisions Decide FOUNDRY COSTS

By E. T. Runge

THE average manager is a capable handler of labor, a good salesman and a fine executive, can handle his factory, but he always dabbles with and invents a costs system. One of the greatest menaces today in the manufacturing field is the amateur cost man. There is really no complication in a good cost system. Neither is there anything mysterious about it.

Basically all foundries, whether they are steel, malleable, gray iron or nonferrous, must have at least four departments; namely, melting, molding, cleaning and core making. If the foundry is divided into these four separate departments, 75 per cent of cost work is performed because by this scheme no expenditure can get into the system unless it gets into some department. Consider sand as an example. Molding sand goes into the molding department, core sand into the core department, etc. It is easy to ascertain to which department any charge belongs. This plan has stood the test of time.

Includes Many Factors

The melting cost of gray iron is made up of a number of factors, including the invoice price of the metal, freight and unloading labor and the invoice price of the coke, freight and unloading labor. To this must be added the labor cost to get the charge into the cupola, the power to operate the blower and elevator, and the proportion of the general administrative and fixed expense, such as depreciation, taxes, insurance, etc. If the metal costs about $20 per gross ton or about one cent a pound and the conversion cost is ½ cent, the cost of iron at the cupola spout is about 1½ cents. Each department delivers its product to the next department. This is the cut-off.

Molding constitutes the foundry operations between the cupola and the cleaning or finishing rooms. For example take a period of one month, which requires $10,000 worth of productive labor. That term is not exactly descriptive because all labor is productive or it would not be used. It should be called recorded labor; that which is practical to record. However, it will be called productive, and non-productive labor. Assume there is $10,000 worth of productive labor used during a certain period. An expense of about $15,000 is incurred in that department made up of: night gang, foreman, labor, sand, supplies, power and the proportion of general administrative and fixed expenses. These include depreciation, insurance, taxes, etc., and form a total cost of $25,000 between the cupola and the cleaning room. How should this expense be handled? A choice of several ways is provided. One of the most popular methods is to distribute it as a percentage on molding labor. Another way is to charge so much per molder per hour or so much per molder per day.

The $25,000 expended in the molding department may be handled in any way to meet any condition, without changing the basic or fundamental cost method, no matter how much it may be necessary to change the details and adapt them to meet particular conditions. Recently a new condition has developed where the mold is not made in the molding room but in the coreroom. Thus that condition may be studied without changing the basic factors involved.

Guessing at Costs

COST information too often becomes a matter of guess work. This situation has been revealed a number of times at meetings of the American Foundrymen's association when contests have been held by the cost committee. At Chicago a year ago, the author presented a problem at the cost meeting and the results covered an exceedingly wide range. This article is abstracted from a paper presented before a recent meeting of the Wisconsin Gray Iron Foundry Group. Milwaukee, The author is a cost consultant at Cleveland.

The third department, cleaning and shipping, includes the process after the castings leave the molding department. If this was called the finishing and shipping department it would be simpler, but due to custom, it is necessary to call it cleaning and shipping. In the cleaning and shipping department, there will be a cost of about $6000 for the monthly period. How will this handled? The $6000 often is figured at so much a pound, for example 60 cents for 100 pounds. It was found that this is not exactly correct. The next plan was to use it as a percentage, for example 50 per cent of the molding labor, or 50 cents a molding hour, or about $3.50 a molding floor or day.

Pound Cost Not Good

Some foundries decided they did not care to use the cost per pound. This was especially true with the large foundries, so it was decided to divide it further into several subdepartments including; sandblasting, tumbling, pickling, grinding, etc. Any method may be used, but one of the best plans is to apply this expense in some form on the molding labor, if it is not desired to do all the work necessary by the subdepartment plan.

The author does not like the cost per pound method. Perhaps some examples will show the reason for this stand. Much loss has been caused by putting the cleaning cost on the cost per pound. For example consider two square plates, each one foot square. One is ½-inch thick, and the other is 1-inch thick. Both have the same molding time and practically the same cleaning time. However, by weight there is twice as much cleaning cost on the 1-inch plate as on the ½-inch. As another example, consider a ball of about 6 inches diameter which weighs about 100 pounds, and another ball, cored, which weighs 50 pounds. Practically the same molding and cleaning time is required. The molding cost might even be a little more, due to the time required to set the core. However, the cleaning time would be the same.

By the weight system only one-half

of the cleaning time goes on the hollow ball. As another example consider a casting weighing 100 pounds. This is cleaned as one piece. On the other hand 100 castings, weighing one pound each, would have to be handled individually. Is it possible to handle and clean the 100 castings as cheaply as one casting weighing 100 pounds?

A small wing nut may require about 200 to make a pound. If the average cleaning cost is ½ cent per pound is it possible to clean 200 of those for ½ cent? It must be remembered surface and not weight is being cleaned. However, if these methods are not satisfactory, the cleaning costs may be divided into several departments. Anything that is desirable to adapt the system to particular conditions can be done as long as the whole of the $6000 expenditure, which was mentioned previously, is charged to the correct department.

The core department should be considered next. Assume that a core manufacturer is selling all the cores to the foundries in a particular district. Consider that a core of one type would cost 10 cents. Why should any of the core cost be charged to a plain casting which does not use a core? This feature will be discussed briefly, showing that recorded or productive labor is found in the core department.

Use Different Methods

Two foundries were located in a particular district. One produced pumps and the other bathtubs. In the pump works the castings had many cores, and the core labor was charged on piece-work basis, amounting to over ½ cent a pound. It paid the management to keep a record on that. In the bathtub foundry one little core was used in each bathtub and one man could make enough in a day to last a month. The cost was so insignificant it was handled as an expense. Both products required cores, but the costs had to be handled to meet conditions.

Most of the pumps were put underground and they did not need to be cleaned exceptionally well. The expense was insignificant, and it was treated as an expense on molding labor. Three piecework cleaning operations were performed on the bathtubs, totaling about $1.87 per 100 pounds, three times as much as the molding. This cost was important enough to be recorded. By dividing the foundry into the four departments (melting, molding, cleaning and core making), it is possible to adapt the system to changing conditions.

An example of the variations existing in cost methods may be shown in the following: One hundred pounds of castings are required. Pig costs $20 per ton or iron at the spout costs 1½ cents, molding labor cost is 1½ cents, and cleaning and finishing is approximately 200 per cent or 3 cents. This produces a total of 6 cents per pound for a plain casting. If the cost of a core and overhead is 2 cents, the total cost per pound of castings is 8 cents. This example has been given around the country and while 95 per cent of the cost data was given, variations between 6 to 12 cents per 100 pounds of castings was revealed. This was due to the different cost methods which were employed.

Gives Five Factors

At the Chicago convention of the American Foundry association the author gave an example of a nonferrous, brass casting. The cost of copper was 25 cents, and the cost of molding and core labor was specified. The cost as determined by the author was about 35 cents per pound. The difference between high and low should not have been over one cent, yet the difference amounted to 26½ cents.

There are five factors which result in great loss in foundries. First is the cash discount of 2 per cent 30 days or 10 days. What does that mean? Two or three per cent a month; 24 to 36 per cent a year on the entire account offered. Money can be borrowed from the bank at 6 per cent. On 500,000 pounds of castings a month, or 10 tons a day, there is a loss of about $5000 a year or better. Approximately 400,000 different corporations are in existence in this country, of which there are about 200,000 manufacturing companies. Of the manufacturers 25,000 make a profit over $5000 per year; another 25,000 make less than $5000 per year, and 150,000 operate in the red. This $5000 cash discount loss would throw a good many over into the black.

The item of freight allowed ranges from 8 to 30 cents per 100 pounds, or averages about 20 cents. The author would like to see a cost f.o.b. foundry, net cash. The foundryman gets little or no cash discount, but sometimes allows 2 per cent and often pays the freight. That easily could amount to another $10,000 a year on a 250 ton a month proposition.

Another custom is in existence. The estimater or *guesstimator* as he has been called, when he figures an estimate, say on a 60-pound casting, asks the practical man, "How much molding?" The practical man may say one hour. Here the practical man and the estimator often talk two different languages. Consider the average molding wage is $7.20 a day of 9 hours. The estimator divides $7.20 by 9 and gets 80 cents per hour. The superintendent says it takes one hour to make it. In a nine hour day the molder often only works about 7¼ hours. There is about an hour and a half not devoted to putting up molds. This $7.20 divided by 7¼ is one dollar instead of 80 cents. Here is a difference of 20 cents and with the overhead 200 per cent or 40 cents makes 60 cents, or one cent per pound on a 60-pound casting. Can you figure how many thousand dollars will be lost because the estimator or cost man is not practical in such cases?

Another loss results from a cored casting. Assume a batch of plain castings weighing 100 pounds has been made at a cost of $4 in the molding and cleaning room. Omit the iron. The customer then changes the design so that a set of cores is required. The cores cost $1.60 for the set. The foundry making the casting has the same cost of $4 and perhaps a little more to set the cores. The 100-pound casting costs 4 cents a pound. The $1.60 for cores brings the cost to $5.60 per 100 pounds. Is that 5.6 cents a pound against 4 cents? No. For the casting now weighs only 70 pounds, so that the cost is $5.60 divided by 70, or 8 cents a pound.

Changes Molding Method

The manufacture of a cored casting involves labor, material, fuel, sand and other expense. There is the hazard in the extra loss involved. Finally the reduction in weight develops. The 500,000 pounds of plain castings a month easily could drop to 350,000 pounds. This 350,000 pounds must stand the cost of the 500,000 pounds, less credit for the iron. The cored casting is one of the greatest problems to which the foundryman must devote study.

For years the accountants have been studying the machine shop carefully. They give exact labor cost, the machine rate and much else. They have the machine shop cost determined to a fine point, but in the past they have neglected the foundry, often averaging it so much per pound. The machine shop is simple compared with the foundry.

One more point remains. Suppose a foundry is running 400,000 pounds a month at a cost of 6 cents or $24,000. The castings have been selling for 6½ cents or $26,000 producing

a profit of $2000. A slump in business develops and the production drops to 100,000 pounds. Mr. Jones is a customer who brings in 100,000 pounds of work. At 6½ cents the revenue is $65,000. What is the cost? The average foundryman assumes it to be one-fourth of $24,000 or $6000. However, there is at least $2000 fixed expense in the $24,000 which is composed of salary, depreciation, taxes, insurance, etc., and only one-fourth of that item has been included. The foundryman must stand this balance of $1500. This makes the cost $7500 with a $6500 revenue, thus showing a loss of $1000. The foundryman becomes excited when he sees his business in the red. He solicits every Tom, Dick and Harry to get a larger volume to reduce the cost. He may sell another 100,000 pounds of castings for 5½ cents or $5500, which with the $6500 makes $12,000 revenue. The cost now is assumed to be one half of $24,000 or $12,000. The company only has taken care of $1000 or $2000 charge fixed expenses. It is necessary to add $1000 to the cost which makes $13,000. With $12,000 revenue, the company still has a $1000 loss.

That is not all of the loss. Originally he had perhaps 40 molders. During the slump he let out all but nine or ten. When he obtained the other 100,000 pounds, he hired an additional ten molders. They weren't as efficient and made more scrap which cost about $300 more, making the loss $1300.

By selling to every Tom, Dick and Harry there was an extra credit hazard in addition. Jones had been satisfied with the service, the delivery and the price, but every Tom, Dick and Harry made it a point to tell Jones, "We only pay 5½ cents for our castings." The chances are fair that Jones will demand his 6½ cents to be cut to 5½ cents, another loss of $1000. Therefore, the final loss is around $2300. Consequently, it may be seen easily that the foundry or any other manufacturing company never has helped itself by selling a product at lower than cost.

Tracing the Cause of Defects

By Albert J. Bond

IN THE production of repetition work, it often happens that the foundry foreman is not aware of his loss on any particular part, until he sees it piled in the cleaning room, or on the inspector's bench.

Naturally it is put out of sight as quickly as possible, the department is charged with the loss, and too often the same defect reappears the next time that particular job runs in the foundry. It is one of the many trials of a foundryman's lot, for while he may have been making one type of casting for ten or 15 years, losses still are encountered.

Pressure castings may be taken as an example. It often happens that a certain size, or type invariably shows a high percentage of leaks under test. These leaks are caused mainly by sand holes, flakes of oxide, or shrink cracks. If caused by sand the molder probably is responsible. If oxide is the cause, the metal used and the melting practice must be investigated. Gating and temperature of metal, when cast, will be thought of if the leaks are due to shrink cracks.

This analysis of loss takes time, much of which may be saved if patterns are marked or numbered. It is assumed that match plates or a similar method of gating and plating suitable for fast production are used. In any case, it is an easy matter to have each pattern marked or numbered, as plainly as possible, depending on whether the part is to be machined, or if not whether a mark would detract from the appearance when finished.

These identifying marks have been found valuable in tracing defects to their source. It may be found that a large proportion of the leaky castings bear the same number. When position of the particular pattern on the plate is known, a possible solution of the problem doubtless will be suggested. Assume that eight patterns are mounted on a plate. If it is found that a large part of the loss is caused by shrink cracks which leak under pressure, and nearly all the defective castings bear the same two numbers, the trouble would appear to be caused by improper gating.

Castings Gated Improperly

Many foundrymen will recall cases within their own experience where the pattern plate had room for, perhaps, 12 pieces, although, if these were spaced with proper regard to scientific gating, the plate should contain only eight or ten patterns. Unfortunately for the reputations of foundrymen, the office usually insists on the larger number, with a consequent higher percentage of loss.

An example of two large flanged castings in a mold may be cited. Patterns and stripping plate were first class, yet the loss was heavy. The defect was due to the failure of metal to cover the core on one casting, the other appearing sound. This case was of particular interest. Since only two castings were in the mold the position of the defective casting could be seen at once with gates removed. In this instance one order would be good, and another later on would be equally bad. Eventually it was found that with good cores and careful molding apparently sound castings would result. However, the soundness was only apparent, for section cutting disclosed the fact that metal was too thick on top of one casting, and too thin on the other, caused by the cores being slightly out of alignment.

Another example is that of a plain ring made eight in a mold. The loss in this case was due to miss-runs. Unmarked the defectives could not be identified. With marks, it was found that they nearly all came from the same part of the gate, and experiments proved that tilting the mold cured the trouble as nearly as any foundry trouble can be cured.

It is suggested that in place of a more or less casual glance at the scrap pile—something far from pleasant in itself—an identifying mark be placed on each pattern which will enable the parts to be correctly rearranged, and so bring the problem nearer to solution.

Marking tends to prevent to some extent what is known as passing the buck. Not that passing the buck in itself is altogether bad, for the temptation to do so doubtless arises more from a man's pride in his work, than from a desire to evade responsibility. Nevertheless, there are men who are disposed to place responsibility on another department rather than go to the trouble of an investigation.

Shift may be the trouble, and the blame placed on loosely fitting flask pins. Had the patterns been marked it might be proved that the patternmaker was at fault when the patterns were plated, as is sometimes true.

Bill Hears of Steel Casting for Diver

By Pat Dwyer

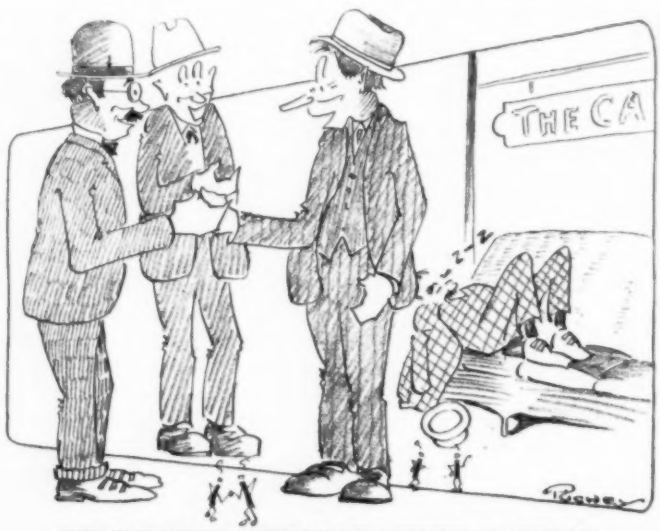
WHILE glancing casually through the pages of the morning paper one day recently, my eye was taken by a small, single column picture of what at first looked like a balloon. A second glance almost conveyed the impression that it was a picture of a steel buoy, familiar to all who have occasion to enter or leave any sea or lake port. Usually they are painted red, although occasionally a black one bobs up.

Up to the present I never have seen any satisfactory explanation for the universal use of these two colors, with the red leading by a comfortable margin. I suppose there is a reason, as there doubtless also is reason for calling the thing a buoy, which is a word that rarely is pronounced correctly, even by the horny handed gentry accustomed to go down to the sea in ships and who venture on the great waters of the deep.

For every one person in 100 who says *buoy*, you can find at least 47 who favor *booey*. The remainder of this imaginary group of 100 is divided about equally among those who say *boy* and those too lazy to open the mouth for the *o* and thus slur the word into *b'y*. The reproduction of the photograph in the paper indicated that the original was painted neither red nor black and that feature—coupled perhaps with a mild interest in all things maritime—caused me to rub the sharp little eyes and favor the picture with a third glance. Then I discovered something I had missed in the first two hurrier glances, the face of a man apparently on the inside of the thing, and peering through a circular glass. Searching for the accompanying text I found a brief caption to the effect that the steel globe had been constructed for the director of a natural history association. He intended to use it instead of a diving bell while engaged in exploring the bottom of the sea in the vicinity of one of the West India islands.

I reflected that the world is made up of all kind of people and if one or more derived any pleasure or profit from studying the ocean floor at close range, they were welcome to the experience. The caption below the picture did not state whether the steel globe was a cast or a welded steel product. In a subconscious manner I associated the object with the steel plate buoys with which I am familiar, and devoted no more thought to the subject.

A few days later I saw a reproduction of the same picture in a Buffalo, N. Y., newspaper, but the accompanying text was no more enlightening than in the first instance and I skipped it idly. Then a Halifax, N. S., paper came into my hands and on one of the inside pages I found the picture again. Just like a habit.



THE WELCOMING COMMITTEE WORKED IN RELAYS

Apparently the device must be of considerable importance since it was receiving so much notoriety or newspaper publicity. I read the caption over again carefully and found that the sphere was a steel casting with a 15-inch opening at one side and three 6-inch openings at the opposite side, each fitted with heavy glass. It was fitted with four feet or brackets on the bottom and carried a boss on the top by which it was suspended from two heavy chains.

That put a different complexion on the subject and I commenced to speculate on how the casting was made, where it was made and on the thickness of metal. Manifestly some nice calculation would be required to hold the weight to a minimum, and still have the casting strong enough to withstand the immense pressure to which it would be subjected at great depths. Also a minimum weight would be desirable to facilitate handling the globe with a winch on the deck of a boat. On the other hand the weight must be sufficient to overcome the displacement, otherwise the enclosed globe would not sink by gravity in the water.

While prowling through the convention hall recently in company with Bill, sizing up the various exhibits, I was reminded of this peculiar casting. I asked Bill if he had seen the picture, or if he had heard anything about it.

"Well, now," said Bill, "that is a curious co-incidence. I was figuring on telling you all about that casting one of these fine summer days."

"Yes?" I inquired. "I suppose you will tell me you made the thing 40 years ago for a watch charm while you were working at the old Thurlow plant in Chester."

"No," Bill replied. "I did not make it and it was not cast 40 years ago in Chester. Mind you, some remarkable castings were made in that old plant, but this particular watch charm was not one of them. I remember one time we made a stern frame—" "Never mind the

stern frame," I interrupted. "I have seen many of them and on sundry and divers occasions have wielded a rammer on them in the days before pneumatic rammers were invented. What I am curious about now is what do you know about this steel globe."

"'Tis a long tale," said Bill, "and a rather peculiar tale and a tale that cannot be told standing up. Let us perch ourselves on one of these comfortable seats and I'll spin the yarn of this deep sea ball. Believe it or not, my lad, this very morning, before I met you I ran into the lad who made that casting a few months ago! Now, what do you think of that, hey?"

"That is a remarkable co-incidence," I admitted. "How do you know he was not kidding you?"

"How do I know?" Bill inquired, testily. "How do I know anything? How do I know you are sitting there asking silly questions? How do I know the sun is shining outside? How do I know what day of the week this is? How do I know that Major Bull is an expert on steel castings and that Eg. Ballard comes from Lynn? I know because I know! How do you know you are alive? Can you prove it? And if so, why?"

"All right," I said. "All right, dear friend and fellow citizen. Your apology is accepted in the same free and generous spirit in which it is offered. Carry on and—er—so forth."

"Carry on, my eye," Bill replied. "How can I carry on when you persist in butting in all the time? Do you know the answer to that one?"

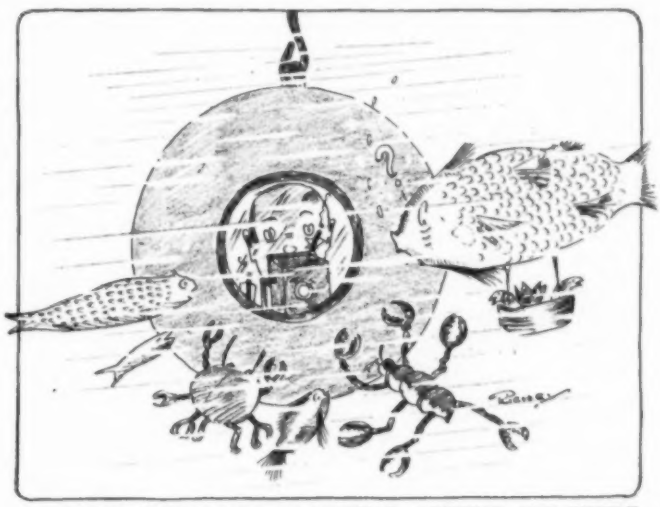
Deep and profound silence on the part of the party of the second part.

Bill settled himself comfortably in his place and proceeded to unfold the yarn. He was interrupted every few minutes by joyous hails from old cronies from all over the country. Each one had to shake him by the hand and exchange reminiscences of their last meeting, whethere it was last month, last year or even back in the days before the American Foundrymen's association was organized.

I suggested at one point that we should adjourn to a less prominent position if he expected to finish the story before the close of the convention. Bill waved the suggestion aside.

"One of the principal reasons I had for coming to this convention," he said, "was to meet all these lads. In the majority of instances I only run into them once a year at one of these annual conventions. Some of them I have not seen for a seemingly incredible period of years when you come to actually count 'em up. I can see you almost any day and tell you the remainder of the story. It is not perishable. It will keep."

"The story may not be of the tender, perishable kind," I said, "but I am. I can't sit around here all day while you are putting on the glad hand act. Up to the present I have not seen half of what I want to see at this show. I have not heard half what I want to hear at the various sessions and I have not met half the people I expected and hoped to meet. If it is all the same to you, we shall consider this meeting adjourned, to be resumed at a more convenient time and place, say six months hence."



INTEREST APPEARS TO BE MUTUAL, OUTSIDE AND INSIDE

"You certainly take my tip, kid," Bill replied with the old fatherly air, "take my tip and stick around here. The crowd is in constant motion and every person inevitably passes this point at some time during the day. You can view the exhibits later and you can read all about what happened at the various sessions. In fact the printed versions sometimes is better than the original, particularly when only a few people in the vicinity of the speaker can hear what he is saying.

"This story of the steel ball attracted my attention when I first heard it because I thought the inventor intended to use it in a search for the treasure which, according to popular tradition, is scattered all over the bottom of the ocean, particularly in the vicinity of the West Indies, the Carribean sea and the gulf of Mexico. Fiction writers have been scuttling treasure ships in these waters since the days of Columbus. It is only natural to assume that the bullion, precious stones and pieces of eight must be piled knee deep on the ocean floor.

"Later I found that the device is to be used off the island of Bermuda. You know, the place where the big Bermuda onions come from, some of them almost as big as the steel globe. Instead of hunting for treasure in silver and gold and precious stones, the inventor is going to study plant and animal life under the usual conditions prevailing at great depths. However, that has no bearing on the casting, a highly creditable product of the foundry.

"Several methods are available for making a job of this kind, each equally satisfactory under a given set of conditions. Thus if a considerable number of castings were required, a complete pattern, split at the equator would have facilitated production and reduced the total cost. The mold could be made half in the floor and half in the cope, or, half in a drag and half in a cope. On account of the shape of the casting, exceptionally strong clamping devices are an actual necessity to prevent a runout at the joint. In another method the drag half of the mold and the entire core might be formed with suitable sweeps either in sand or loam, and the cope might be built in loam, or rammed in sand on top of the core before the thickness was removed. In a third method a skeleton pattern might have been employed to form the mold and core at the same time. The main objection to the skeleton pattern is that it involves considerable expense in the patternshop . Also it is apt to become distorted in the hands of molders who may not be accustomed to working from this style of a pattern.

"In the present instance with only one casting to make and practically no prospect of ever receiving an order for a second casting, patternmaking, coremaking and molding expense had to be held to the absolute minimum. As a matter of fact the patternmaking expense was confined to a couple of strikes, a few loose pieces and a corebox for forming the feet.

"A false half core was made first and this served for a pattern in making the drag and cope halves of the mold. After it had served its purpose it was destroyed. In some instances of this kind the core first is made the size of the pattern and then a thickness of sand is removed corresponding to the desired thickness of metal in the casting. In this particu-

lar instance it was found more economical and convenient to build two new halves the correct size for the core.

"Guides for forming the half spherical core included a wood ring laid flat on the core plate, and two members cut to form arcs of 180 degrees, mounted vertically on the ring and joined in the center to form a cross above the core. A junction piece set in each of the four apexes served as a resting place for the end of the strike employed in forming the contour of the core between each quarter section. The lower end of the strike rested on the wood ring at the bottom where a suitable shoulder guided it accurately. An arbor in the core was provided with suitable hooks by which the core was handled after it was dried, first in placing it on the pattern board and afterward in lifting it out of the drag. This half core-pattern was rammed solid without any precaution for contraction or venting.

"The dried half core was placed upon a pattern, or rollover board, and accurately adjusted on the center lines in the same manner that any split pattern is adjusted to insure a match between the cope and drag, rammed on the same board, and where the right side of the cope must coincide with the left side of the drag and vice versa. In this instance the axial line extended through the center of the large opening at one side and the center of the middle one of the three small openings at the opposite side. The pattern board was provided with suitable projections and depressions to form corresponding projections and depressions on the joint face of the mold and thus insure an accurate match between the cope and the drag. These were in addition to the usual pin guides in the flanges.

"Loose wood pieces were adjusted in place at opposite sides of the core to form the single large and the three small openings. In like manner, block prints were adjusted on the highest side of the core to form openings for the feet cores to be set in later. An upright runner core was placed in one corner of the flask and branch gate cores were attached to each of the feet after the sand had been rammed high enough. The remainder of the drag then was filled with sand, rammed and rolled over. The core-pattern was lifted out and placed back on the board.

"The loose pieces and core prints were removed from the drag, and with the exception of the feet core prints, were reassembled in their place on the half core. The feet cores were placed in the bottom of the drag and the joints packed with sand for the double purpose of holding them in place, and presenting a smooth surface on the mold.

"The cope was prepared in a somewhat similar manner. The runner was adjusted to coincide with the runner in the drag, and large risers were placed over the heavy sections surrounding the various openings and an additional riser over the highest point.

A strike 1¼-inches smaller in diameter than the other was employed to form each half of the core. Each half core was reinforced with rods and the bottom half was provided with hooks for lifting it. Openings were left in the top half of the core so that the entire core might be lifted by hooks attached to the bottom half. After the core was set in place, these openings were filled with sand. Loosely piled coke on the inside insured easy contraction of the core under the pressure of the metal while cooling. Extensions were built on to the main core to form the several openings. These extensions were built long enough to form prints on which the core was supported in the mold.

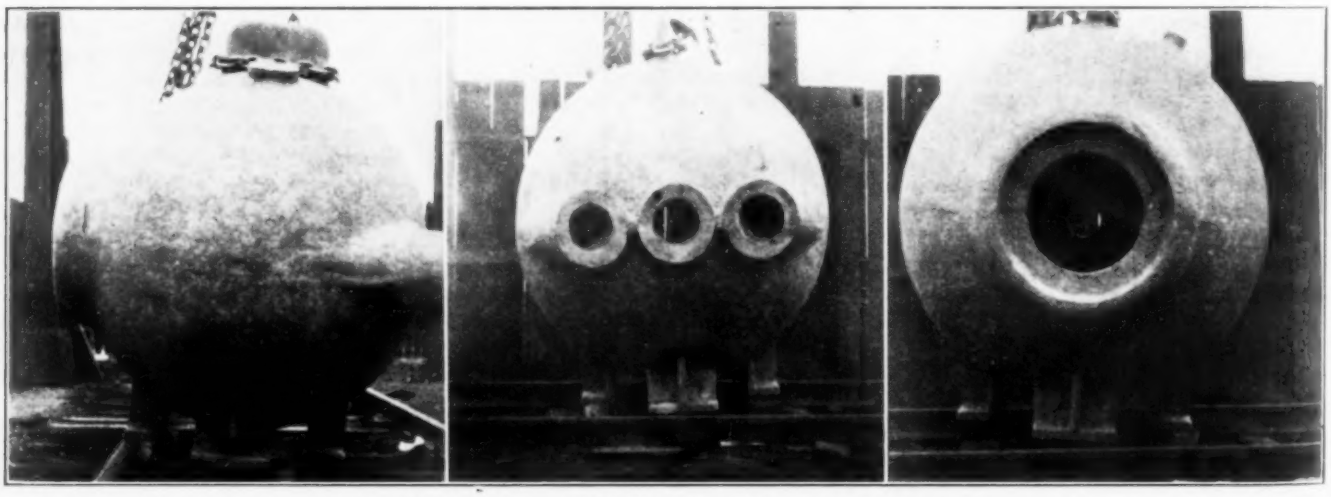
"On account of the tremendous pressure, a number of spool chaplets were distributed over the top of the core, and one long stem chaplet was erected over the top center to hold the core in place. The center chaplet extended through the top riser and was cut off when the riser was removed. Several chaplets also were placed in the bottom to relieve the core prints from sustaining the entire weight.

"In assembling the mold, balls of clay were placed at several points under and over the core to test the thickness and to insure an even distribution of metal.

"Approximately 6000 pounds of metal were required to pour the casting. The metal was melted in an acid lined open-hearth furnace and was of the following composition: Carbon, 0.25 per cent; manganese, 0.40 per cent; sulphur, 0.05 per cent; phosphorus, 0.04 per cent."

"It was a nice job of molding," I said, "but I am afraid I am one of the vast army of common people who cannot see any use in the knowledge that will be gained through the use of the casting. Who cares what goes on at the bottom of the ocean?"

"Well," said Bill. "I'll tell you. The relative value of anything depends on the point of view. Men who are sponsoring this expedition claim that the success of this experiment will be the most remarkable achievement of the age, since it will demonstrate the feasibility of making observations at a depth of a quarter of a mile. However, I have no curiosity in that direction. I can see all I want to see while I have both feet planted on the ground and I have no desire to go creeping around the bottom of the ocean while resembling a worm in an apple!"



FRONT, BACK AND SIDE VIEWS OF A GLOBULAR STEEL CASTING IN WHICH A SCIENTIST PROPOSES TO CARRY ON OBSERVATIONS AT THE BOTTOM OF THE SEA

What Others Are Thinking

Abstracts Selected from the World's Foundry Literature

Gives Use for Gray Iron

Reservoirs de Grande Capacite en Fonte (Large Cast Iron Containers), by M. Delcroisette, *La Revue de Fonderie Moderne*, April 10, 1930.

One of the uses for gray iron castings is in the manufacture of large containers or reservoirs which at present are made of steel plate. The article points out that cast iron has many advantages over steel in that construction especially if the unit must resist acid and other forms of corrosion. Another advantage is that if exported they may be shipped complete while steel containers must be shipped disassembled.

The article deals with the manufacture of square or rectangular containers in Great Britain and Germany. In Great Britain, the containers are made of cast iron flanged panels with bolts fixed in the flanges. This method of construction has the fault of the inferior part expanding from the weight of the fluid. Stay-bolts overcome that difficulty but must be made of steel which either nullifies the advantages of cast iron, or if special stock is used, increases the cost.

The system used in Germany was invented by Dr. Ing. Oskar Kron and also involves the use of cast iron panels. However, those do not have the flanges at right angles but are so placed that the panels form an arch with the convexity toward the inside of the container. At each point where the arches meet on the wall, they are strengthened by right angles or beams which are placed outside the container. By this method of construction, the pressure of the liquid is transmitted by the arches to the structural reinforcement outside the reservoir.

Alloys for Ship Propellers

The Casting of Ship Propellers, *Foundry Trade Journal*, London March 20, 1930.

This article which was abstracted from the German publication *Giessereipraxis*, gives in a condensed form information on the casting of iron and bronze propellers. It tells some of the precautions that must be taken in molding those castings and gives the analysis of the metals best suited.

For cast iron propellers, a mitxure including steel is advised. The analysis should be approximately as follows: Carbon, 2.6 to 2.8 per cent; silicon, 1.7 to 1.8 per cent; manganese, 0.8 to 0.9 per cent; sulphur, 0.08 to 0.10 per cent; and phosphorus, 0.3 to 0.5 per cent. Melting of the charge in an oil-fired rotary furnace also is favored because oil has a lower percentage of sulphur than coke.

The article presents two mixtures that give satisfactory service for bronze propellers. It explains the required physical properties and outlines the melting practice. One of the alloys given contains copper, 57 per cent; manganese, 1 per cent; iron, 1 per cent; nickel, 2 per cent; zinc, 38.5 per cent and aluminum, 0.5 per cent.

Reports on Silicon Measurement

Le Dosage du Silicium dans les Fontes (Quantitative Measuring of Silicon in Cast Iron), *Bulletin*, Association Technique de Fonderie de Belgique, Brussels, April, 1930.

This is a report by the scientific committee of the Belgian association, which is gathering information on the various methods of quantity-measuring the elements of cast iron. The report under review deals with the analysis of silicon.

Various methods of analysis are given, the first one being that recommended by the Association Technique de Fonderie de Paris, followed by a method recommended by Lelong and Mairy, the authors of a treatise on foundry practice. Another method is given which is used by the Spanish metallurgist, Captain Plana. Methods used in various works also are described.

Summarizing these methods, it is shown that the French foundry association recommends the analysis being made on 1 gram of cast iron. Five of the works mentioned take 2.5 grams, one works takes 2 grams, another works takes 2.336 grams, and Captain Plana recommends 4.69 grams. The Belgian committee considers that their best weight for the sample is 2 or 2½ grams, as a larger sample conduces to the use of considerable quantities of acids, and it also takes a long time for the period of evaporation of the silica, for filtration, washing, etc. It should be noted that the weights of 4.69 grams and 2.336 grams were chosen by the respective users because they enabled a table to be prepared easily which gives a direct reading of the contents of silicon in the cast iron. Various technical considerations are given at the end of the article.

Calculates Weights for Molds

Incorrect Weighing of Molds, *Foundry Trade Journal*, London, May 8, 1930.

According to the author, many castings are lost and go to the scrap pile, because improper methods were used in weighting the mold. Generally the loss of a casting because of improper weighting is due to too little weight rather than too much. Many factors must be taken into consideration in calculating the weight required for a casting. Those factors include: Type and size of casting; sizes and weight of box; area and estimated weight of sand when rammed; head pressure; number of runners; and buoyancy.

Three factors are necessary to determine the lifting pressure on a core. Those are: Head; diameter or size of core; and length of core. As an example, the author calculates the lifting pressure on a pipe core with a 4-inch bore, 9 feet long and with a head of 10 inches. The formula used is: Diameter of pipe in feet × length in feet × 450 = static pressure in pounds. Substituting in the formula

$$\frac{4}{12} \times \frac{10}{12} \times 9 \times 450 = 1153.$$

If the weight of the box is 168 pounds and the rammed sand 350 pounds, the weight pressing down against the lifting pressure is approximately 518 pounds. Subtracting that amount from the static pressure gives the weight necessary to counteract the core pressure or 635 pounds. The author says that 10 per cent additional weight should be added to compensate for unforeseen causes. He gives a table showing pressures exerted on pipe core of various diameter and heads. The latter part of the article is devoted to a discussion of clamping methods and distribution of weights on the mold.

Discusses Furnace Theory

Theorie Generale des Fours a Cuve —Son Application aux Cubilots et aux Hauts-Fourneaux (General Theory of Shaft Furnaces—Its Application to Cupolas and Blast Furnaces), by Emilio Damour, *Bulletin*, Association Technique de Fonderie de Paris, February, 1930.

The author first studies the difficulties of the problem of cupola melting from the practical standpoint. He emphasizes the fact that in the shaft furnace it is impossble to see and to control the interior of the furnace. To remedy this difficulty, he recommends regular operation by controling all the factors on which the operator can have an influence, such as pressure and temperature of the blast, height of charges, control of temperature at the top of the furnace, etc.

Passing to the difficulties encountered in the theory of the cupola, particularly from the standpoint of the thermic phenomena, the author explains that these difficulties are due to the fact that the melting of pig iron in the cupola is one of the most complex operations in metallurgy.

The author then takes up in turn the study of the upper, melting and bottom zones from a theoretical point of view.

Following this particular study, he makes several suggestions. It is stated that in a cupola using 8 per cent of coke there must be a loss of heat in the upper zone, and consequently, there is not much interest in trying to obtain complete oxidation so that no carbon monoxide should pass at the top. It is recommended to heat the blast and even to inject into the air a small proportion of coke-oven gas, which makes it easier to control the blast temperature.

The Shakeout

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Managing Editor

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EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

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Assistant Editor

¶ Salutations, Mr. Graduate!

TO YOU, Mr. Graduate of our technical schools and universities, in your ten-thousand fold personality, we offer our felicitations. Our congratulations are untinged by any hint of that alleged humor that pictures the emerging student taking upon his shoulders the burden of Atlas and solving the problems of the entire universe. We know that the engineering graduate has no illusions of grandeur. He wants a job. He seeks to start where he can apply the abstract theory acquired in college to the practical problems of today's industry. You are welcome, Mr. Graduate, in the foundry industry. We need your ambition, your vision and your engineering training. We know you regard your graduation day as truly a *commencement*. Foundrymen of long experience can teach you and guide you. The foundry industry offers proper rewards to the man of ability and application.

¶ Machinery Goes Rural

THE trend toward the mechanization of processes, which has been noted in industry for a number of years, now is apparent in the field of agriculture. The development of the internal combustion engine has permitted large savings in the amount of labor required to produce crops. The rate at which the farming industry is being equipped with motive power is shown clearly by the fact that in 1920 there were 246,083 tractors and 25,199,552 horses and mules in the United States, while in 1929, the number of tractors had grown to 852,989 and the number of horses and mules had decreased to 19,476,000.

MUCH has been written concerning the movement in population from the farm to the urban community. According to Walter H. Lloyd, editor, *The Ohio Farmer*, this is an economic readjustment which undoubtedly will not cease until all high cost farming has been eliminated. The movement is not a matter for alarm, but is necessary to sound national economy. Little farm land has been abandoned, for the yield over a period of years has increased, but farms are being consolidated. Machinery is being introduced more than ever before.

Mr. Lloyd believes that the immediate future of the agricultural implement industry is bright. The ultimate future of course is bound up with the fortunes of agriculture. The fundamental method of solving the problem will lie in constantly increasing efficiency and economy. This movement toward mechanization is of vital interest to the foundry industry, because, as is the case in practically all types of machines, castings constitute the principal engineering materials of farm machinery.

¶ Beware the Volume Stampede

AS LONG as business remains fairly brisk, little is heard about the pernicious and fallacious catchword—*Increase the volume to reduce the cost.* In slack times the clamor grows. In a letter to its members, the Gray Iron institutes states, "The temptation in times like the present when business is not as brisk as it has been, is to disregard more or less the dictates of good business principles. In these times it is particularly apropos for us to remember that the fallacy of large volume as a means to profits, has been disproved on scores of occasions in recent years. Your company is in business for one primary purpose—to fulfill its obligation and duty to the public, the government, and its stockholders. These conditions cannot be met satisfactorily without profitable operations."

IF THE plant operators keep the fundamentals of increasing volume to reduce costs constantly in mind—that is to say labor costs, overhead, price obtained per unit, etc., remain constant while production increases—it is self evident that no difficulty will be encountered. Unfortunately, in the rush to keep the shop full during slack periods, caution is thrown to the winds, and to obtain a larger volume, the selling price per unit is reduced without considering the other factors involved. Consequently, the plant instead of obtaining a profit is operating at a loss. It is essential that every plant operator know his costs to the fraction of a cent, and apply that knowledge before he makes any radical changes. It is easy to stray from the solid ground of profitable operation as is shown in an article on costs in another part of this issue, and the sooner the importance of cost accounting is recognized, the better it will be for the foundry industry.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

A. H. CHAPPELKA, vice president, Lake City Malleable Co., formerly the foundry division of the Chisholm-Moore Mfg. Co., Cleveland, has resigned. Mr. Chappelka was associated with the Chisholm-Moore company from 1902 until 1928 and then assumed a similar position with the Lake City Malleable Co. when it was organized. During the greater part of that period he served as vice president in charge of operations. He was born in

A. H. CHAPPELKA

Cleveland in 1882 and received his education in the public schools of that city. He was a member of the Malleable Iron Research association and was one of the sponsors of the Cleveland Foundry Trade school recently established by a group of Cleveland foundrymen.

C. H. Pape, Independent Foundry Co., Portland, Oreg., has been elected vice president of the Ore-Metal Trades association, Portland.

D. L. Colwell, Stewart Die Casting Co., Chicago, has been elected chairman of the Chicago chapter of the American Society for Steel Treating

Frank M. Meyers, formerly superintendent, Maynard Steel Casting Co., Milwaukee, has been appointed general superintendent of the Atlas Steel Casting Co., Buffalo.

S. Seto, chief foundry engineer, Mitsubishi Dockyard & Engine Works, Kobe, Japan, was a visitor at the recent convention of the American Foundrymen's association. Mr. Seto is visiting the United States to view steel and nonferrous foundry practice.

Ralph Wabiszewski, who has been identified with the Maynard Electric Steel Casting Co., Milwaukee, for the past 12 years, has been appointed foundry superintendent to succeed Frank Meyers, resigned.

David O. Thomas, general manager, Muncie Products division, General Motors Corp., Muncie, Ind., has been appointed general manager, Saginaw Malleable Iron division, General Motors Corp., Saginaw, Mich. John G. Wood formerly director of engineering at Olds Motor Co., Lansing, Mich., will succeed Mr. Thomas at Muncie.

Julian W. Palmer has resigned as vice president and sales manager of the Frost Mfg. Co., Kenosha, Wis., but will retain his interest in the business and continue as a member of the board of directors. He has been associated with the firm, a manfacturer of brass castings, plumbing and heating supplies, etc., for 25 years.

Julius H. Barnes, chairman of the board of the United States chamber of commerce and chairman of the National Business Survey conference appointed by President Hoover last November, has been elected president of the General Bronze Corp., succeeding John Polachek, founder of the company. Mr. Polachek has become chairman of the board and will direct the further development and expansion of the business, while Mr. Barnes, who for some time has been a director, will now take over the active management of the company. Hamilton Pell, vice president, G. E. Barrett & Co., New York, has been elected a director.

Max Kuniansky, formerly works manager of the Lynchburg Foundry Co., Lynchburg, Va., has been appointed works manager of the Radford, Va., plant of the company. Mr. Kuniansky was born in Russia, March 30, 1899 and immigrated to this country in 1907. He was graduated from Georgia School of Technology in 1919 with a B.S. degree in engineering chemistry. After a brief period with the Aetna Explosive Co., New York, and the National Malleable Castings Co., Cleveland, now the National Malleable & Steel Castings Co., he became associated with the American Cast Iron Pipe Co., Birmingham, Ala., in 1920. In September, 1923, he accepted a position as metallurgist with the Lynchburg Foundry Co. Mr. Kuniansky was appointed works manager of the Lynchburg plant of that company on Jan. 1, 1928 and held that position until his appointment May 1, 1930, as works manager of the Radford plant. He

M. KUNIANSKY

is a member of the American Foundrymen's association committee on gray iron castings and subcommittees on pig iron qualities and recomended practice for cupola mixtures. In addition to his membership in the American Foundrymen's association, Mr. Kuniansky is a member of the American Society for Testing Materials.

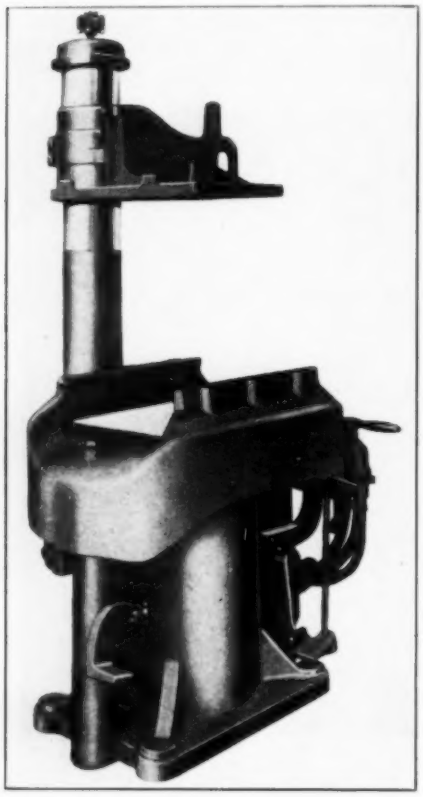
Issues Bulletin

Bureau of standards, U. S. department of commerce, Washington, has issued a bulletin covering its simplified practice recommendation No. R105-29 which limits the stock sizes of wheelbarrows. The bulletin includes sketches of the barrows of various designs that have been approved and gives specifications with each class. The latter part of the bulletin is devoted to a history of recommendation.

Molding Machine Has Large Capacity

William H. Nicholls, Co. Inc., Richmond Hill, Long Island, N. Y., has introduced a new combination jolt, power squeeze, pattern draw molding machine. The machine is especially designed for foundries making snap flask or double faced matchplate work. The device is equipped with long cylinders and pistons which are ground to size. Guide pins, and bushings are made of steel, and are hardened and ground. All drawing parts are inclosed and work in oil.

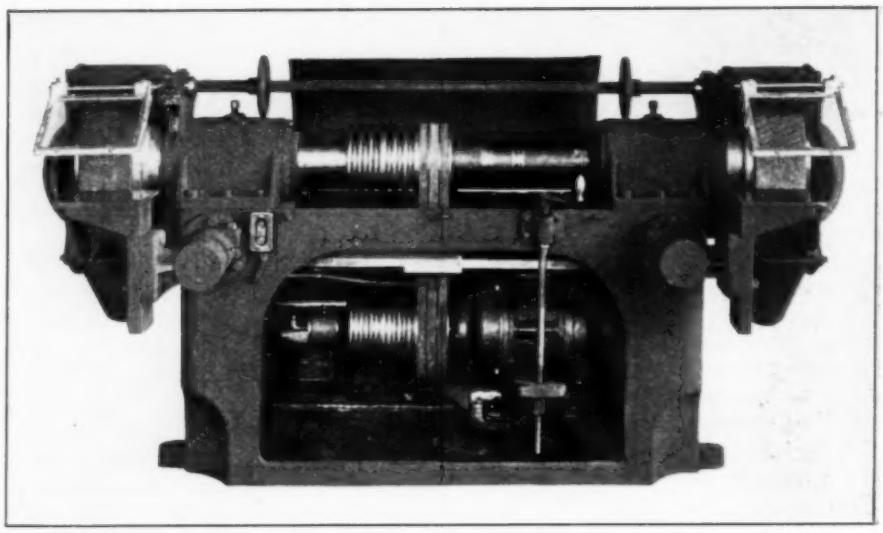
The greatest weight of the machine



ALL DRAWING PARTS OF THE MACHINE WORK IN OIL

is in the base to secure rigidity and to withstand the wear and strain of vibration caused by constant jolting. The upright is double extra heavy tubing designed to withstand at least 50 per cent more strain than that to which the machine is subjected. It also serves as an air reservoir and a water and oil trap. The air supply is piped in at the top of the column.

The squeeze head is made of steel and is sufficiently light to move easily. It is provided with lugs for locating the pattern plate when drawn from the mold. It also is provided with lugs to take up wear. The base and cylinder are cast in one piece with valve brackets, lugs for riddle holder and mold shelf. All operations are performed with one operating valve of the engineer's disk type. The disk in the valve is made of a special bronze, seated on a hardened semi-steel base and is held in position by air pressure. Those parts are finished accurately in surface grinders.



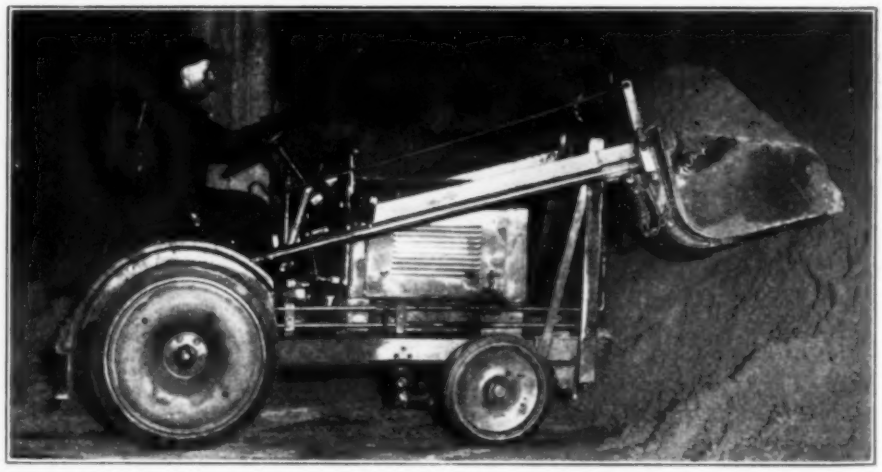
NEW HIGH-SPEED PRODUCTION GRINDER SHOWING SPEED CHANGE SHEAVES

Production Grinder Has Safety Feature

The new 24 to 30-inch, heavy high-speed floor stand production grinder, shown in the accompanying illustration, is made by the Standard Electrical Tool Co., Cincinnati. The work rests and boiler plate hoods with overlapping covers, are movable to accommodate any working condition. A safety control device, working in conjunction with the movement of the hoods, is designed to prevent overspeeding of the wheels, and to give a satisfactory working range of 7500 to 9000 surface feet per minute. The spindle is of 4-inch diameter, 74 inches long, and mounted in four ball bearings. Three speed changes are provided by V-belt drive sheaves on spindle and motor shaft. The power is furnished by a ball bearing motor made by the General Electric Co., and is supplied to the spindle through three V-belts. The motor can be raised or lowered by a lead screw which provides for adjustment of the belt tension. The grinding wheels are ring type, 24 to 30 inches in diameter, with a 12-inch hole for a 2 and 4-inch face, according to the horsepower of the motor. The grinder is made for 10 horsepower with 24-inch diameter wheels and for 15 horsepower with 30-inch diameter wheels.

Operates Power Scoop Without Dismounting

Clark Tructractor Co., Battle Creek, Mich., recently has placed on the market a new type power scoop for the handling of molding sand. The accompanying illustration shows a gas-powered tractor equipped with a 9 cubic foot capacity hopper capable of handling a 1500 pound load. The dimensions of the machine are overall width, 4 feet 7 inches; overall length, 11 feet 4 inches; height with bucket down, 6 feet 3 inches; height with bucket up, 7 feet 8 inches; bucket clearance raised, 4 feet 7 inches; buck-



THE SCOOP IS DRIVEN BY A GASOLINE ENGINE AND IS EQUIPPED WITH A SELF STARTER, GENERATOR AND BATTERY

et clearance dumped, 3 feet 2 inches. The apparatus is equipped with hydraulic cylinders which enable the operator to pick up a load and hold it at any desired point. The driver controls all operations without dismounting. Each machine is equipped with a self-starter, generator, battery, head and tail lights and a tractor type gasoline engine. The Clark company also manufacturers another model power scoop which has bucket clearance of 7 feet 1 inch when raised and 6 feet when dumped.

New Sand Machine Has Compact Design

A portable sand preparing machine recently introduced by the American Foundry Equipment Co., Mishawaka, Ind., has been designed to prepare heap, facing, and core sand, and for odd conditioning jobs when larger production cutting and preparing machines are not available.

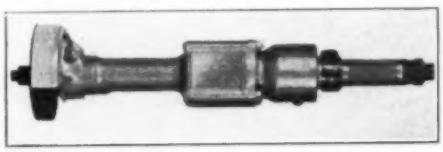
The sand is shoveled or fed through a steel grate into a vibrating hopper which feeds the sand into a rotor housing. In this housing the knives or shoes of a revolving rotor thoroughly cut, mix and blend the sand, and expel it under high velocity from the side of the machine. As it is expelled it first passes through a steel bar grate for elimination of coarse waste parts, and then through a vibrating wire screen for the elimination of finer waste parts. Thus the sand is thrown into a pile, being cooled and aerated once more. Refuse eliminated at three separate points falls to the floor. The machine shown in the accompanying illustration, has capacity to condition as much sand as two men can shovel into it, and easily can be moved from place to place about the foundry to accommodate various jobs.

Grinder Is Adapted To Close Quarters

Following the same general plan of construction used on its series of pneumatic grinders for 6 and 8-inch wheels, the Buckeye Portable Tool Co., Dayton, O., has developed two new grinders for use with 4-inch diameter wheels, vitrified or high speed.

The lower speed model runs at 6000 revolutions per minute and uses either a 4-inch vitrified wheel or a 6-inch high speed wheel. The high speed model runs at 9000 revolutions per minute and uses a 4-inch high speed wheel or various small, cone or pencil grinders.

The new grinders are 18 inches overall and 3 inches in diameter. The small size makes this type usable in close quarters. These grinders are



GRINDERS ARE BUILT FOR 6000 AND 9000 REVOLUTIONS PER MINUTE

equipped with a special throttle governor. Lubrication is provided by an oil chamber. It is claimed that the new grinders are economical in the use of air and operate at high speed under load.

Core Machine Equipped with Ball Bearings

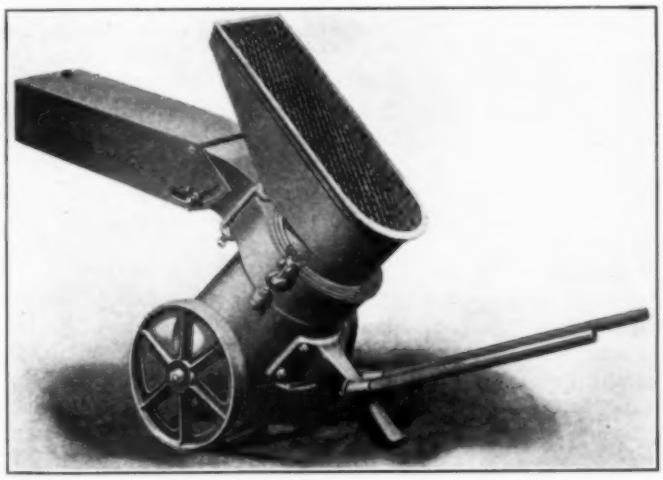
Tabor Mfg. Co., 6225 Tacony street, Philadelphia, has introduced a new hand ram, rollover, core machine which has ball bearings applied to the main pattern drawing guide. Specifications of the machine are as follows: Table, 14 x 16 inches; draw, 8 inches; capacity, 200 pounds; maximum height of core box or flask 10 inches; and height from floor to table, 29 inches. It is supplied with or without the power jarring device.

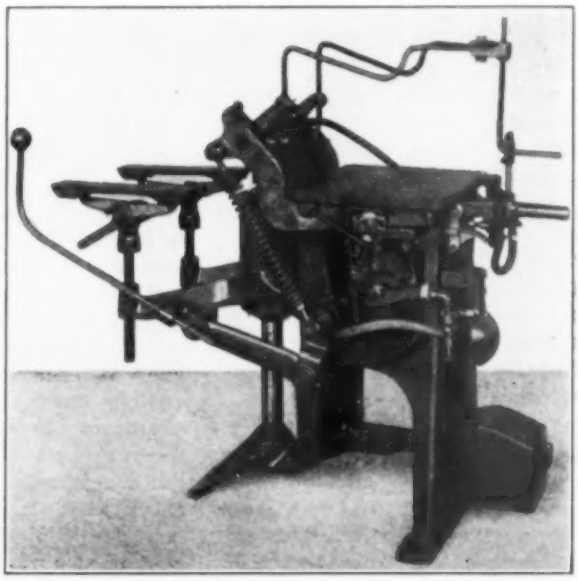
Other features of the machine include special oilless, bronze bushings; adjustable leveling mechanism; bronze counterbalance spring swivels; one size bushings make any replacement; frictionless main guide; hand adjustment of counter-balance springs; hand adjustable core plate clamp; balanced drawing mechanism; and leveling bars attached to leveling mechanism.

The machine is supplied either for hand or jar ramming. If the hand type is secured, the jarring mechanism may be attached at any time. On those machines equipped with the jarring device, the valve is knee operated and the vibrator valve is located on the roll over frame so as to be controlled conveniently by the operator with the same hand used in rolling over the frame. The jarring machine is equipped with a 3-inch diameter piston 10 inches long. Adjustments to the counter balance springs, core plate clamps and leveling device may be accomplished by hand.

The leveling device is of the four point design and is provided with aluminum core plate supports. An adjustment is available to take up any wear on those parts. The rollover frame is of steel. It is provided with adjustable stops and is disengaged from the jarring machine during that operation. The machine normally is supplied with a hand draw lever but a foot type draw may be substituted easily. Provision also is made to locate those levers on either side of the machine to suit the convenience of the operator. While the machine is designed as a core machine, it also may be used as a molding unit.

(BELOW) NEW SAND PREPARING MACHINE IS PORTABLE—(RIGHT) THE MACHINE IS BUILT FOR EITHER HAND OR JAR RAMMING. KNEE CONTROL IS AVAILABLE FOR JARRING





Obituary

George P. Gerlinger, president and treasurer, Gerlinger Brass & Aluminum Foundry Co., West Allis, Wis., died at his home May 14 at the age of 59. Mr. Gerlinger, with his brothers organized the Gerlinger Electric Steel Casting Co. in 1902, at first manufacturing gray iron castings and in 1906 crucible furnaces were installed. From that time until 1914, the company made crucible steel castings. In

G. P. GERLINGER

1914, one of the first electric furnaces in the northwest was installed and the company continued to make steel by that process until 1927 when it was dissolved. George P. Gerlinger and the late W. E. Gerlinger then organized the Gerlinger Brass & Aluminum Foundry Co., which was operated by the two brothers until the death of W. E. Gerlinger in November 1929. Since that time, the business has been carried on by George P. Gerlinger.

Robert Niedergesaess, 84, founder of N. & S. Engine & Foundry Co., Seattle, in 1897, died last week in that city.

Walter Smart McKee, president, Kensington Steel Co., Chicago, died recently following an operation. He was one of the pioneers in the manganese steel casting industry and had been identified with the development of that product for 30 years.

E. D. Green, president, Garden City Fan Co., Chicago, died May 29, at the South Shore Athletic club, Chicago. He was the son of W. W. Green, founder of the company, and was born in Bergen, N. Y. in 1865. He was one of the pioneers in the fan and blower business.

E. J. Woodison, president, E. J. Woodison Co., Detroit died May 23 at Grace hospital, Detroit. Mr. Woodison was born in Ridgetown, Ont., Can., April 23, 1874. He began his career in the foundry supply business as a bookkeeper with the Fredrick B. Stevens, Inc., Detroit. Later he served as salesman for that company and as Detroit representative for the S. Obermayer Co., Chicago. He organized the Detroit Foundry Supply Co., Detroit in 1904 and served as its president until 1911. In that year he organized the E. J. Woodison Co. and was its president until his death. He also was president of the E. J. Woodison Co., Ltd., Toronto, Ont.; vice president, Canadian Foundry Supplies & Equipment Ltd., Montreal; vice president, M. A. Bell Co., St. Louis; president, Acme Foundry Co., Detroit; and was a director of the Standard Foundry Supply Co., Walkerville, Ont.; Apex Foundry Co., Detroit; H. S. Lee Foundry & Machine Co., Plymouth, Mich., and had interests in other foundries. He had been in ill health for several years and had not taken an active interest in the E. J. Woodison Co. for the past 2½ years.

NewEnglandFoundrymen Hold Meeting

R. F. Harrington, metallurgist, Hunt-Spiller Corp., Boston, was the speaker at the June meeting of the New England Foundrymen's association, held June 11, at the Engineers club, Boston. Mr. Harrington spoke on "Sand Control, Conservation and Reclamation on the Production of Quality Castings." He spoke of the application of various types of clay bond and presented a number of samples of clays, molding and shop sands.

Publishes Booklet

The Ajax Metal Co., Philadelphia, this year is celebrating its fiftieth year in the nonferrous ingot field. In honor of the occasion of its golden anniversary, the company has published a booklet which gives the officers, views of its plants, and the story of the formation and advancement of the company through the succeeding years. The story outlines the advent of the company into the nonferrous ingot field and also explains the development of the induction furnaces that it manufactures. Each new development is listed as a mile post in the progress of the company.

Ohio Founders To Meet at Canton

A meeting of the Ohio Foundries Association Inc., will be held June 18, at the Brookside Country club, about 2 miles from Canton, O. Luncheon is scheduled for 12:30 p. m. Immediately following the luncheon, the meeting will be called to order with Robert Hopkins, president, Alliance Brass & Bronze Co., Alliance, O., as general chairman. Following a talk by D. A. Williston, Nock Fire Brick

E. J. WOODISON

Co., Cleveland, and Laclede-Christy Clay Products Co., St. Louis, on "Refractories as Pertaining to the Foundry Industry," there will be a discussion of Ohio's new foundry code. The leader of the discussion has not been named.

Immediately after the two talks, the group will be divided into four divisions on steel, malleable, gray iron and nonferrous, for roundtable discussions which will be under the leadership of the following: Steel, Ted Harvey, Ohio Steel Foundry Co., Lima; malleable, L. P. Henry, Maumee Malleable Casting Co., Toledo and nonferrous, R. Hopkins, Alliance Brass & Bronze Co., Alliance. Following the roundtables, golf will be available. A meeting of the directors of the association also is scheduled.

To Expand Foreign Trade

L. W. Greve, treasurer of the Cleveland Pneumatic Tool Co., Cleveland, and J. F. Wallace, chief engineer for the same company, are in Europe making a tour of nine countries and investigating industrial, commercial and financial situations.

Trade Trends in Tabloid

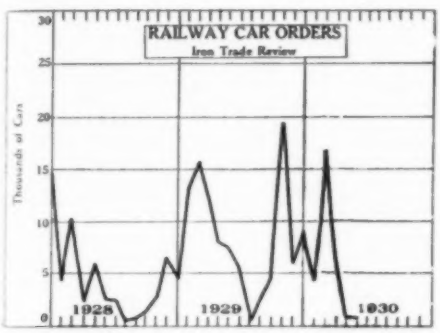
GRAY iron foundry operations in the Chicago district, according to estimates, average 60 to 65 per cent. Steel foundry activity is a few points above gray iron operations. Brass shops are working about four days a week with foundries in general casting from three to four and a half days a week.

—T—T—

Continued declines in the price of iron and steel scrap indicate that the bottom has not been reached in this market.

—T—T—

Early reports from automobile manufacturing centers indicate that



production in June will show a slight drop from May. Iron and steel requirements of the industry are slackening perceptibly.

—T—T—

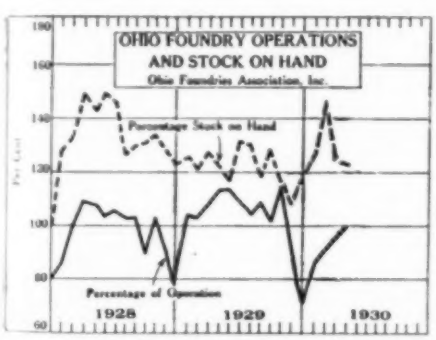
Domestic freight car awards touched the lowest point of the year in May with a total of 1286 cars purchased. The total for the first five months is 31,076 compared with 56,930 during the same period in 1929.

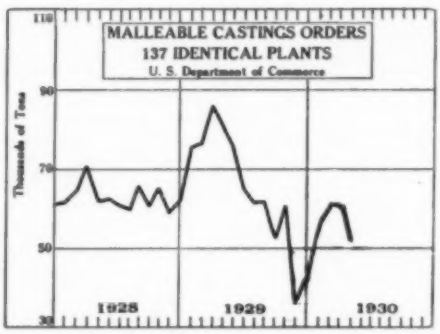
—T—T—

An operator of a steel foundry in the Pittsburgh territory reports that business is fair in the district and that it seems to be improving gradually.

—T—T—

Foundry operations in the St. Louis district are reported as spotty.





The melt during the last half of May dropped slightly below that of the first part of the month, and the total for the month was below that in April.

—T—T—

Buying of machine tools continues to lag. While several companies, such as radio manufacturers are planning on resuming production in a large way soon, few machines will be needed since the plants already are well equipped.

—T—T—

Daily production of pig iron in May declined 1.8 per cent over the rate for April, according to *Iron Trade Review*. Total output was given as 3,239,772 tons while the average daily rate was 104,609 gross tons. Merchant iron production in May was 616,055 tons, which is a slight gain over the month of April and is the second highest total of the year.

—T—T—

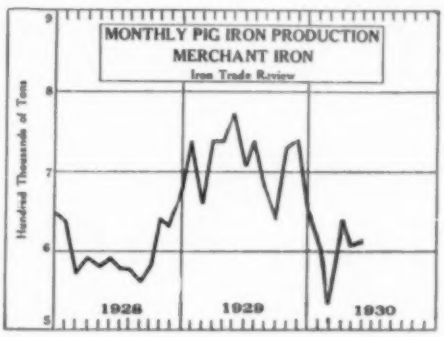
Steelmaking operations receded the first week in June to about 70½ per cent, compared with 73-74 per cent the precious week.

—T—T—

The approach of the third quarter has revived some interest in the pig iron market, although business continues at a point below the normal for the season.

—T—T—

Declines were shown in orders for enameled sanitary ware in April. Orders for baths totaled 55,366 units



compared with 68,672 in March and orders for sinks called for 70,028 units against 83,230 in March. That is a decline of 10,306 of the former and 13,202 of the latter.

—T—T—

Loadings of revenue freight in the week ended May 24 increased 1468 cars from the preceding week. The total loadings for the week was 931,472 cars.

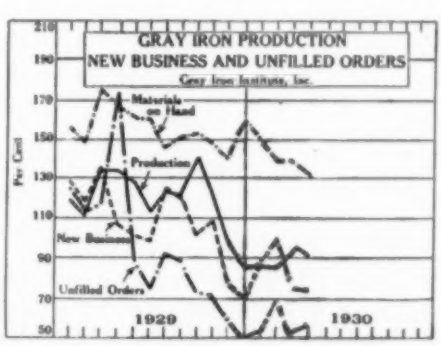
—T—T—

Average New Prices prices of nonferrous metals, according to *Daily Metal Trade*, were as follows in May; Casting copper, 12.641c, electrolytic copper, 13.01c; Straits tin, 32.169c; lead, 5.52c; antimony, 7.430c; aluminum, 23.90c. Zinc averaged 4.638c, East St. Louis, Ill.

RAW MATERIAL PRICES

June 6, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	14.00
No. 2 foundry, Chicago	18.50 to 19.00
No. 2 foundry, Buffalo	18.50
Basic, valley	18.00
Basic, Buffalo	18.00
Malleable, Chicago	18.50 to 19.00
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.50
Scrap	
Heavy melting steel, Valley	$16.00
Heavy melting steel, Pitts.	15.00 to 15.50
Heavy melting steel, Chicago	12.25 to 12.75
Stove plate, Buffalo	11.00 to 11.50
Stove plate, Chicago	9.50 to 10.00
No. 1 cast, New York	10.25
No. 1 cast, Chicago	13.00 to 13.50
No. 1 cast, Philadelphia	14.50 to 15.00
No. 1 cast, Pittsburgh	14.00 to 14.50
No. 1 cast, Birmingham	13.00 to 14.00
Car wheels, iron, Pittsburgh	15.50 to 16.00
Car wheels, iron Chicago	13.50 to 14.00
Railroad malleable, Chicago	15.25 to 15.75
Agricultural mal., Chicago	13.00 to 13.50
Malleable, Buffalo	15.50 to 16.00
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	12.50
Electro, copper, producers	13.00
Straits, tin	30.87½
Lead, New York	5.50
Antimony, New York	7.12½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Alumium, No. 12, remelt	15.50
Zinc, East St. Louis, Ill.	4.60 to 4.65



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Howard Foundries Inc., Franklin Park, Ill., recently was damaged by fire.

Shilling Foundry Co., 688 Henry street, Columbus, O., recently suffered damage to its storeroom by fire.

Pacific States Cast Iron Pipe Co., Ironton, Utah, will build a 1-story plant addition. Cost of the new construction is estimated at $50,000.

Ward Foundry Inc., Blossburg, Pa., is making improvements to its plant. Further additions are contemplated.

Ideal Foundry & Machine Co., Dayton, O., has been incorporated with $5000 by Joseph M. Conroy Co., 900 Albany street.

St. Marys Foundry Co., St. Marys, O., recently poured a 16,000 pound casting for the machine tool industry. That casting was the largest ever made in the foundry.

Otter River Foundry Co., Otter River, Mass., manufacturer of stoves, suffered damage to its plant building recently by fire. Loss is estimated at $10,000.

Walworth Mfg. Co., 88 Pearl street, Boston, will build a 2-story plant building adjoining its gray iron foundry at Kewanee, Ill., for the production of valves and parts.

H. J. McDermott, 489 Como place, St. Paul, has a building permit for a small foundry. The cost of the new construction is estimated at $2000.

Garrett Brass & Aluminum Foundry, Garrett, Ind., recently added a 25 x 50 foot brick addition to its foundry. It will house the melting department. Alfred J. Bahr is works manager.

The pattern department of the Illinois Steel Co., Eighty-seventh street and Burley avenue, Chicago, recently was damaged by fire. The loss is estimated at $15,000.

Pattern Products Mfg. Co., 406 West Jefferson street, Detroit, has awarded a contract for a plant building on Hancock avenue to the Rutherford Sickler Co., 415 Brainard avenue.

Danko Pattern & Mfg. Co., 31 Lee street, Baltimore, maker of metal and wood patterns, will build a 1-story, 50 x 100-foot plant on Keyworth avenue.

Holland Furnace Co., Twenty-second and Columbia streets, Holland, Mich., contemplates building a plant addition that will cost $100,000.

Gardner-Denver Co., Quincy, Ill., manufacturer of pumps, has plans through Behrensmeyer & Hafner, architects, for a 1-story foundry building on South Front street. The new structure will cost about $25,000.

Beaver Dam Pattern Co., Beaver Dam, Wis., has broken ground for a 1-story shop addition. The building will be 40 x 95 feet and the present force of 20 men will be doubled upon completion.

James Morrison Brass Mfg. Co. Ltd., 93 Adelside street, Toronto, Ont., has plans through Catto & Catto, 1 Wellington street East, for a 4-story plant addition to cost $175,000. Bids now are being received for the construction.

Wheeling Mold & Foundry Co., Wheeling, W. Va., has conveyed a strip of land in North Warwood to the Wheeling Steel Corp. The plot will be used for a part of the new addition to the Akerman Mfg. Co. plant.

Jacob Libovitz recently has perfected plans for the establishment of a foundry at Napoleon, O., to specialize in inlets, rings and manhole covers. The company also will manufacture brass and aluminum castings.

Otis Steel Co., Cleveland, O., recently announced an expansion program for its Lakeside works to include three 500-horsepower boilers and an annealing furnace for electric steel castings. Welding and grinding equipment will be added to the electric-foundry department.

Reliance Steel Casting Co., Pittsburgh, is building an extension to its cleaning room which will about double the area of the finishing department. C. L. Snowden is secretary. (Noted June 1.)

Henry G. Haupt advises that the iron foundry he is building at Huntsville, Ala., is 25 x 85 feet. Construction work is being done by John Branumn, contractor. Machinery will consist of a cupola and blower, a stand type grinder, and a tumbling barrel. (Noted May 15.)

Chemung Jersey Foundry Co., Elizabeth, N. J., recently formed by the acquisition of the Zoll Foundry Co., by the Chemung Foundry Corp., Elmira, N. Y., will build a building, 40 x 100 feet. Machinery for the new addition has been purchased. (Noted June 1.)

Mosher Steel & Machinery Co., 900 South Austin street, Dallas, Tex., subsidiary of the Houston Structural Steel Co., and a manufacturer of castings and forgings, has purchased 48,000 square feet of industrial property adjoining its plant.

Davis Bronze & Aluminum Foundry, Tippecanoe City, O., headed by Harry Davis, 1003 West Race street, Troy, O., recently started production. The company is located at North Second and Walnut streets and will specialize in the production of brass, bronze and aluminum castings.

Patterson Foundry & Machine Co., East Liverpool, O., has announced through Richard L. Cawood that construction of a steel foundry will begin immediately. A large power plant will be constructed in addition to the foundry to supply power to the Patterson Foundry & Machine Co., Patterson Steel Products Co., The Patterson Refractories Co., and other subsidiaries. (Noted June 1.)

Ohio Steel Foundry Co., Lima, O., has started a $75,000 expansion program at its recently acquired Bay City, Mich., plant. The new addition will be 75 x 75 feet and will house the melting department. Open-hearth furnaces are to be installed to succeed the Bessemer process and the maximum capacity of the shop will be increased from 400 to 750 tons. Contract for the new construction has been let to the Henry C. Weber Construction Co., Bay City. (Noted May 15.)

New Trade Publications

FIRE CLAY—Illinois Clay Products Co., Joliet, Ill., has issued a folder describing the materials prepared and the services rendered in the delivery of its products.

TUMBLING MILLS—W. W. Sly Mfg. Co., Cleveland, has printed a folder describing a new type of tumbling mill which it has introduced. Illustrations and specifications are given.

FLUXING AGENTS—G. S. Evans, metallurgist, has published a pamphlet for the Mathieson Alkali Works, Inc., describing its fused soda ash fluxing agent. Cupola chemistry and the action of the product described, is taken up.

STEEL CASTINGS—Industrial Steel Casting Co., Toledo, O., outlines in a current bulletin the advantages of steel castings for many uses and the provision for careful work in the company's foundry.

HEATING UNITS—American Blower Corp., Detroit, has published a booklet describing the heating apparatus it produces for industrial use. Description of radiators equipped with fan blowers and data and drawings covering the design and uses are included.

FIRE BRICK—A. P. Green Fire Brick Co., Mexico, Mo., has published a well illustrated booklet describing its plant and methods of manufacture of fire brick products. Description of the complete tunnel kiln plant features the booklet.

NONFERROUS ALLOYS—Ajax Metal Co., Philadelphia, has published a booklet relating its progress in the last fifty years in the introduction of nonferrous alloys and electric furnaces. The achievements of the company from 1880 to the present are related.

ROTATING FURNACE—Whiting Corp., Harvey, Ill., has printed a folder describing its rotating air furnace fired with pulverized coal. Illustrations and description are given covering the use of this furnace in melting malleable iron, gray iron, and special irons. The furnaces are made in 2½, 5, and 10-ton sizes.

MATERIAL HANDLING—A description of material handling equipment in a medium-size foundry is included in a pamphlet published by the Northern Engineering Works, Detroit. The floor-plan, pictures of the equipment, and data on use are given.

MOLDS—Vulcan Mold & Iron Co., Latrobe, Pa., to give an idea of the wide variety or molds in its line, has issued a leaflet with halftones of many varieties of molds in many sizes and for many purposes. A list of their uses is also presented.

ALLOY STEEL—International Nickel Co., New York, has published a pamphlet discussing the weight and strength relationships of alloy steels in railroad boiler plate, castings and forgings. Corrosion resisting material, nitriding and other developments are treated briefly.

INDUCTION MOTORS—General Electric Co., Schenectady, N. Y., has issued two folders describing its 20-200 horsepower solid shaft vertical induction motors and its constant speed, high power-factor capacitor motors. Illustrations and tables covering capacities, etc., are included. A description and illustration of starting rheostats for repulsion induction motors is contained in a third folder.

BLOWERS—Wilbraham-Green Blower Co., Pottstown, Pa., has issued bulletins, 1-14, F-13, F-16 and G-15, describing and illustrating its cupola blowers, gas exhausters and gas pumps. The principle of operation of the positive high duty blowers is illustrated and specifications are given. Both the reducing gear and direct driven types of cupola blowers are described, and illustrations of typical uses are shown for the pumps, blowers, and exhausters.